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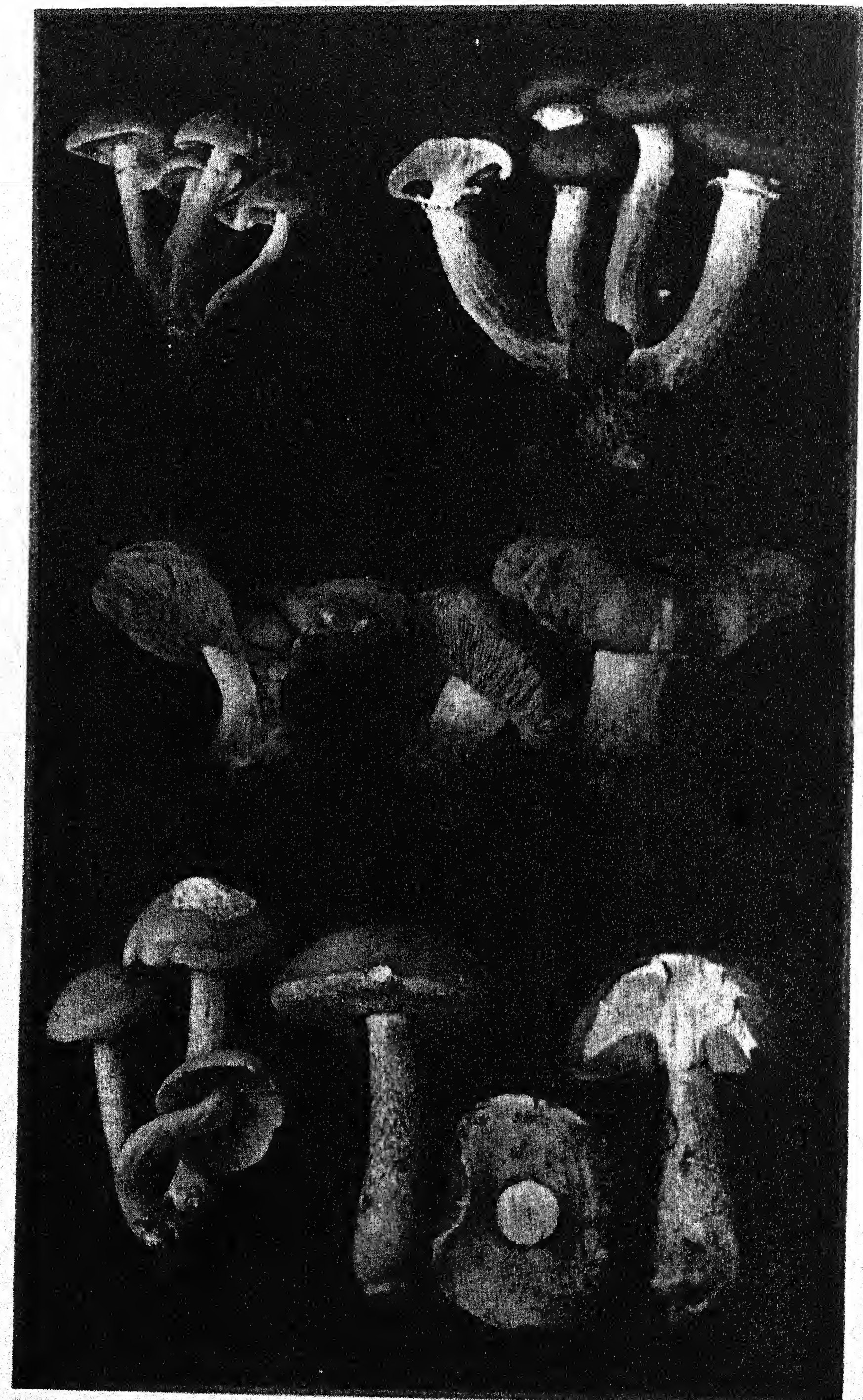


ILLUSTRATIONS OF FUNGI

(In the original issue of this number, Plate I was colored).

MYCOLOGIA

VOL. I JANUARY, 1909 No. 1

ILLUSTRATIONS OF FUNGI—I

WILLIAM A. MURRILL

Each number of this journal will contain a plate representing certain species of fungi in their natural colors. The photographic work for these illustrations is being done by Mr. F. C. Berte and the color work by Mr. E. C. Volkert. Technical descriptions and notes of interest will accompany each plate.

Hypholoma perplexum (Peck) Sacc.

PERPLEXING HYPHOLOMA

Plate 1. Figure 1. $\times \frac{2}{3}$

Pileus 5–8 cm., convex to nearly plane, smooth, glabrous, dry, slightly umbonate at times, latericeous to bay, the margin cream-colored to ochraceous; flesh of mild flavor, white or nearly so, becoming yellowish with age; gills adnate, somewhat rounded, sometimes slightly decurrent, thin, narrow, crowded, pale yellow, becoming greenish, and finally purplish-brown from the ripening spores, which are ellipsoid, smooth, purplish-brown, $7–8 \times 4\,\mu$; stipe 6–10 cm. long, 5–7 mm. thick, subequal, firm, hollow, slightly fibrillose, stramineous above, ochraceous or reddish below, ornamented with an arachnoid ring when young, which becomes conspicuous by reason of the spores which collect upon it.

This species occurs abundantly on stumps and roots of deciduous trees in autumn, appearing in conspicuous reddish clusters of considerable size. It is edible, but not very good in quality, being useful because of its very late appearance. Peck separated it in 1872 from *H. sublateritium* chiefly because it lacked the bitter taste ascribed to that species, of which it may be only a form.

In collecting this species for food, young and fresh specimens of mild flavor should be selected, and they should be cooked for at least thirty minutes.

Armillaria mellea (Vahl) Quél.

HONEY AGARIC

Plate 1. Figure 2. × ½

Pileus convex to expanded, 4–12 cm. broad, very variable, usually dry, smooth or becoming striate toward the margin, pale honey-yellow to dark reddish-brown, usually adorned with minute tufts of brown or blackish hairs, which are more abundant on the disk; flesh white or whitish, somewhat acrid and unpleasant to the taste; gills adnate or decurrent, white or whitish, becoming discolored or spotted with age; spores ellipsoid, smooth, hyaline, 7–10 μ long; ring white, cottony, with dark specks, or thin, arachnoid and evanescent; stem melleous, reddish-brown or dirty-brown below, paler above, nearly equal, firm, fibrous, spongy within, usually floccose-scaly below the ring, 4–12 cm. long, 5–15 mm. thick.

Very widely distributed and very abundant on stumps and buried roots of both deciduous and evergreen trees, on which it grows as a parasite, the sporophores appearing in dense clusters in autumn and the shining brown cords or *rhizomorphs* being often seen in dead logs and stumps. To the forester this is probably the most important species of all the gill-fungi. It is also much used as an article of food in Europe and about New York City, although of inferior quality.

Tricholoma equestre (L.) Quél.

EQUESTRIAN TRICHOLOMA

Plate 1. Figure 3. × ½

Pileus convex to expanded, depressed at the center, 8–12 cm. broad, yellowish or reddish, the disk darker, glabrous or slightly scaly, margin flexuous; flesh white or slightly yellowish, rather unpleasant in flavor; gills broad, nearly free, rounded behind, close, sulphur-yellow; spores ellipsoid, smooth, hyaline, 6–8 × 4–5 μ; stipe short, thick, solid, variable in shape, white with yellow or red markings, 3–6 cm. long, 1–2 cm. thick.

This edible species is conspicuous and beautiful, but not abun-

dant. It occurs in autumn in sandy soil under or near evergreen trees in Europe and the northeastern United States.

Clitocybe multiceps Peck

MANY-HEADED CLITOCYBE

Plate 1. Figure 4. × ⅓

Pileus 3–8 cm. broad, convex to expanded, smooth, glabrous, watery-white to pale avellaneous-isabelline, the disk more grayish; flesh milk-white, mild, somewhat oily, firm and persistent; gills adnate or slightly decurrent, rarely sinuate, white or pale stramineous, close and narrow; spores globose, smooth, hyaline, 5–7 μ; stipe 5–10 cm. long, 7–15 mm. thick, cylindrical, equal, solid or stuffed, firm, white or pale stramineous, pruinose above.

This species occurs in wet weather in dense clusters on lawns, especially in rather long grass, and is usually found in great abundance when found at all. Its flesh is firm, with a slight oily flavor, and sporophores may be kept for several days before cooking. It is known only from New York and a few adjoining states, but should stand transplanting in sod rather easily. Having used it in quantity from my own lawn, I can recommend it as a valuable edible species.

Boletus scaber Bull.

ROUGH-STEMMED BOLETUS

Plate 1. Figure 5. × ⅓

Pileus convex, 3–12 cm. broad, very variable in color, white, red or brown, usually smooth and glabrous; flesh white, becoming slightly darker or flesh-colored when bruised; tubes long, slender, depressed about the stem, white or stramineous, becoming brownish with age and flesh-colored or blackish when bruised; spores oblong, smooth, brown, 13–16 μ long; stem firm, solid, tapering upward, 5–15 cm. long, 1–2 cm. thick, whitish, roughened with numerous reddish or brownish dots or scales.

This is a very handsome edible species and the most abundant of the fleshy tube-bearing fungi, being found on the ground in woods or groves from June to November. Most of the boleti are edible, but a few are considered dangerous and should be well known by the beginner before any specimens of the group are collected for food.

THE BOLETACEAE OF NORTH AMERICA—I

William A. Murrill

The Boletaceae are fleshy tube-bearing fungi, terrestrial for the most part, and, with one or two exceptions, centrally stipitate. They differ from the Polyporaceae chiefly in their fleshy consistency and terrestrial habit. Most of them are edible, but a few species are said to be distinctly poisonous.

The family shows few lines of cleavage, although a number of genera have been proposed since Linnaeus included all tube-bearing fungi in the single genus *Boletus*. S. F. Gray, in 1821, divided the group into three genera, *Suillus, Pinuzza* and *Leccinum*. *Strobilomyces* was separated by Berkeley in 1860, and *Boletinus* by Kalchbrenner in 1877. More recently, Karsten, Quélet, and Patouillard have each originated or adopted a system of classification for the group involving a number of genera, which will be discussed in their proper order in the following pages.

Synopsis of the North American Genera

Tubes arranged in radiating rows.	
Stipe annulate.	1. *Boletinus.*
Stipe exannulate.	2. *Boletinellus.*
Tubes not arranged in radiating rows.	
Stipe either glandular-dotted or annulate.	
Stipe annulate, glandular-dotted in some species.	
Spores brownish-black, rough, subglobose.	3. *Strobilomyces.*
Spores ochraceous to yellowish-brown, smooth, usually oblong-ellipsoid.	
Sporophore covered with a conspicuous yellow powder.	4. *Pulveroboletus.*
Sporophore not covered with a yellow powder.	
Pileus floccose-verrucose, dry.	5. *Boletellus.*
Pileus smooth, viscid.	6. *Boletus.*
Stipe glandular-dotted, exannulate.	7. *Rostkovites.*
Stipe neither glandular-dotted nor annulate.	
Spores hyaline, often becoming yellowish; stem hollow, not reticulated.	8. *Gyroporus.*

Spores rosy or flesh-colored; stem solid, usually reticulated. 9. *Tylopilus.*
Spores ochraceous to yellowish-brown.
Mouths of tubes red or reddish-brown, tubes yellowish within. 10. *Suillellus.*
Mouths of tubes never uniformly red nor reddish-brown, tubes unicolorous. 11. *Ceriomyces.*

1. BOLETINUS Kalchbr. Icon. Sel. Hymen. Hung. 4: 52. *pl. 31.* 1877

Euryporus Quél. Ench. Fung. 163. 1886. (Type species, *Euryporus cavipes* (Opat.) Quél.)

Boletopsis P. Henn. Engl. & Prantl, Natur. Pflanz. 1^{1**}: 194. 1899. Metonym.

Hymenophore annual, terrestrial or rarely epixylous, centrally stipitate; surface dry, minutely silky to fibrillose or squamose: context whitish or yellowish, fleshy or spongy; tubes large, shallow, elongated, tough, not easily separating, radiately arranged, adnate or slightly decurrent, yellowish, covered with a veil: spores elongated, smooth, yellowish-brown to purplish-brown, sometimes with greenish tints: stipe more or less annulate, spongy or hollow within.

Type species, *Boletus cavipes* Opat.

Stipe hollow; pileus tawny-brown, fibrillose-squamulose. 1. *B. cavipes.*
Stipe solid.
Pileus whitish or grayish, slightly squamulose. 2. *B. grisellus.*
Pileus yellow or yellowish.
Pileus 5 cm. or less broad. 3. *B. Berkeleyi.*
Pileus 10 cm. or more broad. 4. *B. appendiculatus.*
Pileus red or reddish, conspicuously squamose.
Spores purplish-brown; scales scattered. 5. *B. spectabilis.*
Spores ochraceous-brown; scales dense. 6. *B. pictus.*

1. BOLETINUS CAVIPES (Opat.) Kalchbr. Icon. Sel. Hymen. Hung. 52. *pl. 31.* 1877

Boletus cavipes Opat. Comm. de fam. fung. Bolet. 11. 1836.

Boletus ampliporus Peck, Ann. Rep. N. Y. State Mus. **26**: 67. 1874. (Type from North Elba, New York.)

This species occurs sparingly in this country in New England and New York, usually in swamps or damp mossy places. It was at first referred to *B. subtomentosus* by Peck.

2. BOLETINUS GRISELLUS Peck, Mem. N. Y. State Mus. 3: 169. *pl 52. f. 13–19.* 1900

This rare species was described from specimens collected by Morris at Natick, Ellis, and Waltham, Massachusetts. It grows under or near tamarack trees, and develops late in the season.

3. **Boletinus Berkeleyi** nom. nov.

Boletus decipiens B. & C. Ann. Mag. Nat. Hist. II. 12: 430. 1853. Not *Boletus decipiens* Schrad. 1794.

Boletinus decipiens Peck, Bull. N. Y. State Mus. 2: 78. 1889.

This species occurs in thin woods along the Atlantic seaboard from New Jersey to Florida. The central stem and much broader, ochraceous-ferruginous spores distinguish it from *B. merulioides* in dried plants where the veil may be inconspicuous.

4. BOLETINUS APPENDICULATUS Peck, Bull. Torrey Club 23: 418. 1896

Only a single pileus remains of the type specimen collected by Yeomans under fir trees in Washington, D. C. Peck's description is as follows:

"Pileus fleshy, convex, glabrous, ochraceous-yellow, the margin appendiculate with an incurved membranous veil, flesh pale-yellow, unchangeable; tubes rather small, yellow, their mouths angular, unequal, becoming darker or brownish where wounded; stem solid, slightly thickened at the base, yellow; spores pale-yellow, oblong, .0004 to .0005 in. long, about .00016 broad; pileus 4 to 8 in. broad; stem 2 to 3 in. long, 4 to 6 lines thick."

5. BOLETINUS SPECTABILIS Peck, Ann. Rep. N. Y. State Mus. 23: 128. *pl. 6. f. 1–3.* 1872

This showy species occurs sparingly in exposed northern swamps in Canada and the northern United States from New England and New York to Wisconsin. The pileus is adorned with conspicuous red scales; the flesh and tubes are yellow, the latter soon colored darker by the purplish-brown spores.

6. BOLETINUS PICTUS Peck, Bull. N. Y. State Mus. 2: 77. 1889

Boletus pictus Peck, Ann. Rep. N. Y. State Mus. 23: 128. 1872.

Boletus Spraguei B. & C. Grevillea **1**: 35. 1872. (Type from New England.)

This beautiful species, described from New York by Peck, is rather common in the woods and mossy swamps of the mountainous regions of the eastern United States and Canada. It is distinguished from *B. spectabilis* by its lighter-colored spores and the denser covering of reddish, fibrillose scales on the surface of its cap.

DOUBTFUL SPECIES

Boletinus borealis Peck, Bull. Torrey Club **22**: 206. 1895. Described from dried specimens collected by Waghorne on Capstan Island, Labrador. The types at Albany resemble *B. cavipes*.

2. **Boletinellus** gen. nov.

Hymenophore annual, terrestrial or sometimes attached to buried roots, pileus circular, varying to dimidiate at times; surface dry, minutely tomentose to floccose-tomentose: context white or yellowish, fleshy; tubes decurrent, large, shallow, elongated, not easily separating, radiating, yellow, not covered with a veil: spores elipsoid, smooth, some shade of brown: stipe central, eccentric or lateral, solid, fleshy or spongy.

Type species, *Boletinus porosus* Peck.

Stem eccentric or lateral; pileus reddish-brown, glabrous or minutely tomentose.	1. *B. merulioides.*
Stem central.	
Pileus dark chestnut, subtomentose.	2. *B. castanellus.*
Pileus bright red, floccose-tomentose.	3. *B. paluster.*

1. **Boletinellus merulioides** (Schw.)

Daedalea merulioides Schw.; Proc. Acad. Sc. Phila. **4**: 160. 1832.

Paxillus porosus Berk.; Lea, Cat. Cinn. Plants 54. 1849.

Boletus lateralis Bundy, Geol. Wisc. **1**: 398. 1883.

Boletinus porosus Peck, Bull. N. Y. State Mus. **2**: 79. 1889.

This species is well known throughout the eastern United States from Canada to Alabama and as far west as Wisconsin. It occurs gregariously in low wet places, especially about stumps and decaying roots, where there is partial shade. In the speci-

men described by Schweinitz the stipe was reduced to a mere tubercle and the pileus was dimidiate in shape.

2. **Boletinellus castanellus** (Peck)

Boletinus castanellus Peck, Bull. Torrey Club **27**: 613. 1900. (Type from New Jersey.)

This species, the type of which I have not seen, was described as follows from specimens collected by Mr. E. B. Sterling in New Jersey:

"Pileus convex or nearly plane, dry, subtomentose, soft, spongy, dark chestnut, flesh whitish or yellowish-white; tubes nearly plane in the mass, adnate or slightly decurrent, brown, their mouths large, angular; stem short, solid, glabrous, colored like the pileus, whitish or grayish within, slightly reticulate at the top; spores 7.5–10 μ long, about 5 μ broad.

"Pileus 2.5–4 cm. broad; stem about 2.5 cm. long, 4–8 mm. thick."

3. **Boletinellus paluster** (Peck)

Boletus paluster Peck, Ann. Rep. N. Y. State Mus. **23**: 132. *pl. 6. f. 4–7.* 1872. (Type from North Elba, New York.)

Boletinus paluster Peck, Bull. N. Y. State Mus. **2**: 78. 1889.

This attractive little species occurs in wet places, usually among moss, and is readily known by its brilliant color and the entire absence of an annulus. It has been collected in Ontario, Maine, Massachusetts, New York, and New Jersey.

3. STROBILOMYCES Berk. Outl. Brit. Fung. 236. 1860

Eriocorys Quél. Ench. Fung. 163. 1886. (Type species, *Eriocorys strobilacea* (Scop.) Quél.)

Hymenophore annual, terrestrial, centrally stipitate; surface of pileus and stipe blackish and shaggy: context white, at first fleshy, becoming tough; tubes angular, adnate, white when young, covered with a floccose veil: spores globose or broadly ellipsoid, rugulose, blackish-brown: stipe solid, not reticulate.

Type species, *Strobilomyces strobilaceus* (Scop.) Berk.

1. STROBILOMYCES STROBILACEUS (Scop.) Berk. Outl. Brit. Fung. 236. 1860

Boletus strobilaceus Scop. Anni Hist. Nat. **4**: 148. *pl. 1. f. 5.* 1770.

Boletus squarrosus Pers. Myc. Eur. **2**: 145. *pl. 19.* 1825.
Boletus coniferus Pers. Myc. Eur. **2**: 146. 1825.
Boletus strobiliformis Dicks. Crypt. **1**: 17. *pl. 3. f. 2.* 1785.
Boletus stygius Wallr. Fl. Crypt. 4: 608. 1833.
Eriocorys strobilacea Quél. Ench. Fung. 163. 1886.

This common edible species is easily known by its black color and shaggy appearance. Its flesh is white, changing to reddish and finally to black when wounded. It is abundant on shaded banks in woods throughout Europe, Canada, and the United States.

DOUBTFUL SPECIES

Boletus coccineus Fries, Epicr. Myc. 423. 1838. Not *Boletus coccineus* Bull. 1791. This species, of doubtful affinities and doubtful locality, is based upon a brief description and a figure (Plum. Fil. Amer. *pl. 167. f. A.A.*). It is placed by Saccardo in the genus *Strobilomyces.*

4. **Pulveroboletus** gen. nov.

Hymenophore annual, terrestrial, centrally stipitate; surface of pileus and stipe clothed with a conspicuous sulphur-yellow, powdery tomentum, which may be the remains of a universal veil: context white, fleshy; tubes adnate, yellowish, covered with a large veil: spores oblong-ellipsoid, ochraceous-brown: stipe solid, annulate, not reticulate.

Type species, *Boletus Ravenelii* B. & C.

1. **Pulveroboletus Ravenelii** (B. & C.)

Boletus Ravenelii B. & C. Ann. Mag. Nat. Hist. II. **12**: 429. 1853.

This beautiful and interesting species was first described from the collections of Ravenel in South Carolina, and has since been collected in many of the eastern states from New England to the Gulf of Mexico. It differs from most other higher fungi in preferring deep shade, being often found in dense thickets of *Kalmia* and *Rhododendron.* The conspicuous veil and the yellow powder which covers the entire sporophore will readily distinguish this species.

5. **Boletellus** gen. nov.

Hymenophore annual, epixylous, centrally stipitate; surface floccose-verrucose, yellowish: context light-colored, fleshy; tubes

angular, depressed, yellowish, covered with a veil: spores oblong-ellipsoid, smooth, ferruginous: stipe solid, white, not reticulate.

Type species, *Boletus Ananas* Curtis.

1. **Boletellus Ananas** (Curtis)

Boletus Ananas Curtis, Am. Jour. Sci. & Arts, II. **6**: 351. 1848.
Boletus isabellinus Peck, Bull. Torrey Club **24**: 146. 1897. (Type from Mississippi.)

The characters of the genus will readily distinguish this species. It was for a long time known only from the Carolinas, but has more recently been collected many times in Alabama and Mississippi by Professor and Mrs. F. S. Earle, and once in Georgia by Dr. R. M. Harper. According to Professor Earle it always occurs either as a wound parasite on pine trunks or about the base of living pine trees. *Boletus isabellinus* Peck was described from undeveloped specimens.

6. BOLETUS (Dill.) L. Sp. Pl. 1177. 1753

Tubiporus Paul. Traité Champ. *pl. 166* (*bis.*). 1812–1835. (Type species, *Tubiporus annulatus* (Bull.) Paul.)
Suillus Poir. Encycl. Méth. Bot. **7**: 496. 1806. (Type species, *Suillus annulatus* Poir.)
Pinuzza S. F. Gray, Nat. Arr. Brit. Pl. **1**: 646. 1821. (Type species, *Boletus flavus* Bolt.)
Cricunopus Karst. Rev. Myc. 3^9: 16. 1881. (Type species, *Cricunopus luteus* (L.) Karst.)
Viscipellis Quél. Ench. Fung. 155. 1886. (Type species, *Viscipellis sphaerocephala* (Barla) Quél.)

Hymenophore annual, terrestrial, centrally stipitate; surface viscid, glabrous: context fleshy, white or yellowish; tubes adnate, small, angular, yellowish, covered with a whitish veil: spores oblong-ellipsoid, or rarely globose, smooth, yellowish-brown: stipe solid, annulate, often glandular-dotted.

Type species, *Boletus luteus* L.

Stem glandular-dotted.
 Stem not at all reticulate. 1. *B. luteus.*
 Stem reticulate above the annulus. 2. *B. amabilis.*
Stem not glandular-dotted.
 Spores globose or subglobose. 3. *B. sphaerosporus.*
 Spores oblong-ellipsoid. 4. *B. Clintonianus.*

1. BOLETUS LUTEUS L. Sp. Pl. 1177. 1753

Boletus annulatus Pers. Syn. Fung. 503. 1801.

Tubiporus annulatus Paul. Traité Champ. *pl. 166* (*bis.*). 1812–1835.

Boletus Elbensis Peck, Ann. Rep. N. Y. State Mus. **23**: 129. 1872. (Type from Elba, New York.)

Boletus salmonicolor Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 100. 1874. (Type from Vermont.)

Cricunopus luteus Karst. Rev. Myc. 3^9: 16. 1881.

Viscipellis luteus Quél. Ench. Fung. 155. 1886.

Boletus subluteus Peck, Bull. N. Y. State Mus. $\mathbf{1}^2$: 62. 1887. (Type from New York.)

Ixocomus luteus Quél. Fl. Myc. Fr. 414. 1888.

Boletus acidus Peck, Bull. N. Y. State Mus. no. **105**: 15. *pl. T. f. 1–6.* 1906. (Type from Port Henry, New York.)

This species is well known and widely distributed, occurring commonly in sandy soil in coniferous or mixed woods throughout the eastern United States and Europe, and probably extending around the globe in temperate regions. The cap is smooth, yellowish-brown, and very viscid; the tubes and stem are yellow, the latter glandular-dotted and also provided with a large annulus, which is the chief character distinguishing it from *R. granulatus.*

2. BOLETUS AMABILIS Peck, Bull. Torrey Club **27**: 612. 1900

Described from specimens collected by Bartholomew in dense spruce woods in Colorado. The cap is glabrous, reddish-tawny, and probably viscid when fresh; the tubes short, yellow, somewhat radiating, and decurrent; and the stem subequal, paler than the cap, and reticulate above the small whitish annulus. No. 340 of Clements' Crypt. Form. Colorad., distributed as "*Boletus bovinus unicolor* (Frost)," may be this species, but I have not seen satisfactory material of it, nor have I seen the type of *B. amabilis.*

3. BOLETUS SPHAEROSPORUS Peck, Bull. Torrey Club **12**: 33. 1885

This rare species was described from material collected near Madison, Wisconsin, by Trelease. It is known to occur also

in Iowa and Minnesota, being found in low ravines and sandy places in woods, and occasionally about stumps. The sheathing annulus is very characteristic, as are the globose spores, both characters being very rare among the Boletaceae.

4. BOLETUS CLINTONIANUS Peck, Ann. Rep. N. Y. State Mus. 23: 128. *pl.* 5. *f.* 1–5. 1872

Boletus viridarius Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 100. 1874. (Type from Vermont.)

Boletus serotinus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 100. 1874. (Type from Vermont.)

This rather rare species was described from North Elba, New York, and is to be looked for in shaded grassy places in the northeastern United States and Canada. I have collected it twice in central Maine and once in Newfield, New Jersey, the latter collection being made as late as October 25. It is readily distinguished from its congeners of the eastern United States by the absence of glandular dots on the stem.

7. ROSTKOVITES Karst. Rev. Myc. 3^9: 16. 1881

Hymenophore annual, terrestrial, centrally stipitate; surface viscid, glabrous or hirtellous: context fleshy, yellowish; tubes adnate, angular, yellow, not covered with a veil, exuding viscid drops which blacken on drying: spores oblong-ellipsoid, smooth, yellowish-brown: stipe solid, glandular-dotted, exannulate, not reticulate.

Type species, *Rostkovites granulatus* (L.) Karst.

Pileus glabrous or nearly so.
  Pileus brown when moist, yellowish on drying; stem over 8 mm. in diameter. — 1. *R. granulatus.*
  Pileus yellow, often streaked with bright red; stem usually slender, 8 mm. or less in diameter. — 2. *R. Americanus.*
Pileus adorned with conspicuous tufts of hairs. — 3. *R. hirtellus.*

1. ROSTKOVITES GRANULATUS (L.) Karst. Rev. Myc. 3^9: 16. 1881

Boletus granulatus L. Sp. Pl. 1177. 1753.

Boletus circinans Pers. Tent. Disp. Meth. Fung. 27. 1797.

Boletus lactifluus With. Arr. Brit. Pl. ed. 4. 4: 314. 1801.

Leccinum lactifluum S. F. Gray, Nat. Arr. Brit. Pl. 1: 647. 1821.

Boletus collinitus Peck, Ann. Rep. N. Y. State Mus. 23: 129. 1872.

Boletus albus Peck, Ann. Rep. N. Y. State Mus. 23: 130. 1872. (Type from the Adirondacks, New York.)

Boletus viscosus Frost, Bull. Buffalo Soc. Nat. Hist. 2: 101. 1874. (Type from Vermont.) Not *B. viscosus* Venturi.

Boletus punctipes Peck, Ann. Rep. N. Y. State Mus. 32: 32. 1879. (Type from Gansevort, New York.)

Boletus brevipes Peck, Ann. Rep. N. Y. State Mus. 38: 110. 1885.

Viscipellis granulata Quél. Ench. Fung. 156. 1886.

Ixocomus granulatus Quél. Fl. Myc. Fr. 412. 1888.

This species is common in Europe and throughout the United States and Canada, occurring in scattered groups in open woods, especially under or near pine trees. The surface of the cap is very viscid and usually of a brownish color when moist, becoming yellow on partial drying; the stem and tubes are yellowish, and exude viscid dots which become black on drying. There is an albino form, to which Peck gave the name *Boletus albus*. In *Boletus viscosus* of Frost, the stem is rather shorter than usual, a character which Peck kept in mind when he rechristened the species *Boletus brevipes*.

2. **Rostkovites subaureus** (Peck)

Boletus subaureus Peck, Ann. Rep. N. Y. State Mus. 39: 42. 1886. (Type from Day, New York.)

Boletus Americanus Peck, Bull. N. Y. State Mus. 1^2: 62. 1887. (Type from New York.)

Boletus flavidus Peck, Ann. Rep. N. Y. State Mus. 23: 129. 1872.

This species resembles *R. granulatus* in appearance and also in habitat. It does not occur in Europe, although it has very commonly been referred to *B. flavidus*. In its usual form, the cap is yellow and dotted or streaked with brilliant red, the stem being slender, yellow, and covered with reddish-brown, viscid dots which become black on drying. There are forms, however, which are distinguished with difficulty from *R. granulatus*.

3. **Rostkovites hirtellus** (Peck)

Boletus hirtellus Peck, Bull. N. Y. State Mus. 2: 94. 1889. (Type from New York.)

This rare species was at first confused by Peck with *R. subaureus,* but it is easily recognized by its hirtellous pileus. It is known to occur in sandy soil under pines in New York and Connecticut.

8. GYROPORUS Quél. Ench. Fung. 161. 1886

Suillus Karst. Bidr. Finl. Nat. och Folk 37: 1. 1882. (Type species, *Suillus cyanescens* (Bull.) Karst.)

Hymenophore annual, terrestrial, centrally stipitate; surface dry, minutely tomentose to floccose-squamose: context white, less compact than in most members of the family and therefore drying more readily; tubes free, small, cylindrical, white, not covered with a veil: spores ellipsoid, smooth, white, at length pale-yellow: stipe soft and spongy within, usually becoming hollow.

Type species, *Gyroporus cyanescens* (Bull.) Quél.

Flesh quickly changing to blue when wounded; pileus grayish-yellow, floccose. 1. *G. cyanescens.*
Flesh white, unchangeable; pileus reddish-brown, nearly glabrous. 2. *G. castaneus.*

1. GYROPORUS CYANESCENS (Bull.) Quél. Ench. Fung. 161. 1886

Boletus cyanescens Bull. Herb. Fr. *pl. 369.* 1787.
Boletus constrictus Pers. Syn. Fung. 508. 1801.
Leccinum constrictum S. F. Gray, Nat. Arr. Brit. Pl. 647. 1821.
Boletus lacteus Lév. Ann. Sci. Nat. III. 9: 124. 1848.
Suillus cyanescens Karst. Bidr. Finl. Nat. och Folk 37: 1. 1882.

This is a very distinct species, easily known by the deep-blue color which its flesh and tubes assume when wounded. It occurs quite commonly in woods and open places throughout eastern Canada and the northern United States from Maine to Minnesota and south to North Carolina.

2. GYROPORUS CASTANEUS (Bull.) Quél. Ench. Fung. 161. 1886

Boletus castaneus Bull. Herb. Fr. *pl. 328.* 1786.
Suillus castaneus Karst. Bidr. Finl. Nat. och Folk 37: 1. 1882.

This species is quite common in sandy soil in open woods throughout this country and Europe. It is one of the few boleti that dry easily, the same being true also of *G. cyanescens.*

9. TYLOPILUS Karst. Rev. Myc. 3[9]: 16. 1881

Dictyopus Quél. Ench. Fung. 159. 1886. (Type species, *Dictyopus felleus* (Bull.) Quél.)

Rhodoporus Quél. Fl. Myc. Fr. 420. 1888. (Type species, *Rhodoporus felleus* (Bull.) Quél.)

Hymenophore annual, terrestrial or rarely epixylous, centrally stipitate; surface dry, glabrous or minutely tomentose: context white, fleshy, sometimes bitter; tubes small, angular, white, becoming flesh-colored from the spores, not covered with a veil: spores oblong-ellipsoid, smooth, rosy or flesh-colored, rarely inclining to ferruginous: stipe solid, even or reticulated.

Type species, *Tylopilus felleus* (Bull.) Karst.

Pileus yellow to brown.
  Sporophore large; stipe 1 cm. or more thick.
    Context decidedly bitter. 1. *T. felleus.*
    Context not bitter. 2. *T. indecisus.*
  Sporophore usually small; stipe about 5 mm. thick, never reticulate. 3. *T. gracilis.*
Pileus black or blackish; tubes becoming blackish when wounded. 4. *T. alboater.*

1. TYLOPILUS FELLEUS (Bull.) Karst. Rev. Myc. 3[9]: 16. 1881

Boletus felleus Bull. Herb. Fr. *pl. 379.* 1787.

? *Boletus modestus* Peck, Ann. Rep. N. Y. State Mus. **25**: 81. 1873. (Type from New York.)

Boletus ferrugineus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 104. 1874.

Dictyopus felleus Quél. Ench. Fung. 159. 1886.

Rhodoporus felleus Quél. Fl. Myc. Fr. 420. 1888.

This species is abundant and widely distributed both in this country and in Europe. Specimens have been frequently found over a foot in diameter. It is said to be poisonous.

2. **Tylopilus indecisus** (Peck)

Boletus indecisus Peck, Ann. Rep. N. Y. State Mus. **41**: 76. 1888.

This species was described from Menands, New York, and has since been reported from New Jersey, Pennsylvania, Kentucky, and North Carolina. I have found it in several localities, usually in thin deciduous woods. Specimens referred to *B. alutarius* Fr. by American collectors probably belong in this category; but it is difficult to distinguish either species from *T. felleus,* except by taste.

3. TYLOPILUS GRACILIS (Peck) P. Henn.

Boletus gracilis Peck, Ann. Rep. N. Y. State Mus. 24: 78. 1872.

This is usually a small plant, of slender habit, occurring in woods on the ground or on much decayed logs or stumps. It sometimes attains a diameter of 6 cm., but is easily distinguished, even when of maximum size, by its subferruginous spores. The type specimens were collected near Garrisons, New York; it has since been collected in Nova Scotia, New England, New York, Pennsylvania, West Virginia, North Carolina, Georgia, and a few other eastern states.

4. **Tylopilus alboater** (Schw.)

Boletus alboater Schw. Schr. Nat. Ges. Leipzig 1: 95. 1822.

Boletus nigrellus Peck, Ann. Rep. N. Y. State Mus. 29: 44. 1878. (Type from Sandlake, New York.)

This species is not often collected, but is easily recognized when once seen. It occurs in open deciduous woods in the eastern United States from New York to Mississippi. The type collection was made in North Carolina, and the description was evidently drawn from young plants before the white tubes had been colored by mature spores.

10. **Suillellus** gen. nov.

Hymenophore annual, terrestrial, centrally stipitate; surface glabrous or nearly so, dry or slightly viscid: context white or yellow, fleshy, very firm, considered poisonous; tubes usually free, small, yellowish within, their mouths closed when young, and red or orange from the first, not covered with a veil: spores oblong-ellipsoid, smooth, yellowish-brown, sometimes with greenish tints: stipe solid, usually reticulated or dotted.

Type species, *Boletus luridus* Schaeff.

Flesh quickly and distinctly changing to blue when wounded. 1. *S. luridus.*
Flesh scarcely changing color when wounded; pileus shining, blood-red; stipe blood-red, conspicuously reticulated. 2. *S. Frostii.*

1. **Suillellus luridus** (Schaeff.)

Boletus luridus Schaeff. Fung. Bav. **3**: *pl. 107.* 1770.

Boletus tuberosus Bull. Herb. Fr. *pl. 100.* 1782.

Boletus rubeolarius Bull. Herb. Fr. 326. *pl. 490. f. 1.* 1791.

Boletus Satanas Rostk. in Sturm, Deutsch. Fl. **5**: 97. *pl. 31.* 1844.

Boletus Sullivantii B. & C. Syll. Crypt. 152. 1856. (Type from Ohio.)

Boletus vermiculosus Peck, Ann. Rep. N. Y. State Mus **23**: 130. 1872. (Type from New Baltimore, New York.)

Boletus magnisporus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 103. 1874. (Type from Vermont.)

Boletus firmus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 103. 1874. (Type from Vermont.)

Boletus Spraguei Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 103. 1874. (Type from Vermont.) Not *B. Spraguei* B. & C. 1872.

Boletus subvelutipes Peck, Bull. N. Y. State Mus. **2**: 142. 1889. (Type from New York.)

Boletus Underwoodii Peck, Bull. Torrey Club **24**: 145. 1897. (Type from Alabama.)

Boletus chamaeleontinus Atk. Jour. Myc. **8**: 112. 1902. (Type from Cayuga Lake, New York.)

This species is abundant, widely distributed, and exceedingly variable, especially in the color of the cap and in the surface characters of the stem. I have usually found it on clay banks or roadsides in open deciduous woods, but it has been reported from many different habitats. It has been generally considered poisonous, and should be regarded at least as suspicious.

2. **Suillellus Frostii** (Russell)

Boletus Frostii Russell; Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 102. 1874. (Type from Vermont.)

Boletus alveolatus B. & C.; Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 102. 1874. (Type from New England.)

This very handsome species was collected by Frost in considerable quantity near Brattleboro, Vermont, and is known to occur sparingly also in Connecticut, New York, New Jersey, Pennsylvania, District of Columbia, Tennessee, and Indiana. Its favorite habitat is thin oak woods, where the light is sufficient to enable grass to grow. Specimens collected by Sprague were returned by Berkeley under the name *B. alveolatus* B. & C., which was published by Frost with a description. Meanwhile, Berkeley had decided that the plant was only a form of *B. edulis* (Grevillea **1**: 36. 1872.)

DOUBTFUL SPECIES

Boletus parvus Peck, Bull. Torrey Club **24**: 145. 1897. Described from specimens collected by L. M. Underwood in grassy woods near Auburn, Alabama. I have been unable to find the types of this species either at Albany or New York.

NOTES ON NORTH AMERICAN HYPOCREALES—I. NEW AND NOTEWORTHY SPECIES

Fred J. Seaver

The genus *Hyponectria,* founded by Saccardo in 1878, differs from *Nectriella* in the subepidermal character of the perithecia. Six species have been referred by Saccardo to this genus, in various volumes of his Sylloge Fungorum, one of which, *Hyponectria Gossypii* (Schw.) Sacc., the only North American representative of the genus, has since been shown not to be a fungus at all.* This leaves the genus, at present, entirely unrepresented in North America so far as the records show.

In working over the material in the Ellis collection at the New York Botanical Garden, one species, *Nectriella Cacti* Ellis & Everh., has been found to show the true hypodermal character of the perithecia and should be referred to this genus. The ostiola form disc-like expansions above the surface of the epidermis but the perithecia themselves, while prominent, are covered by the thin epidermis of the host, a fact which was not mentioned by Mr. Ellis in his original description and one which apparently escaped his notice.

One species of this genus has also been collected by the writer in North Dakota on dead stems of herbaceous plants. As in the preceding, the perithecia of this species are prominent, though covered, forming minute, orange pustules scattered over the surface of the host. The ostiola also form the disc-like, slightly hairy expansions above the surface of the epidermis. This form is distinct in its spore characters from the preceding as well as from any of the species which have been previously described as representative of this small genus and is here offered as new, being now one of the two representatives of the genus for North America.

* U. S. Dept. Agric. Div. Veg. Phys. Path. Bull. 17: 51. 1899.

In addition to the above, one species of *Nectria* was collected and studied by the writer during the autumn of 1906 which it is thought best to describe at this time. The plants occur on partially decayed seeds of skunk-cabbage (*Spathyema foetida*) and were collected commonly during the autumn of the above date in a swampy place in the vicinity of New York City. The conidial phase which forms a whitish or pinkish mass over the surface of the decaying seeds, has much the gross appearance of some of the common species of *Fusarium* but differs in its microscopic details. The perithecia later appear in small clusters seated on the stromata formed by the conidial phase of the plant. During the past season, 1908, the locality in which this species was originally collected was visited once, but at that time none of the plants were found.

HYPONECTRIA Sacc. Michelia 1: 250. 1878

Perithecia globose or subglobose, subepidermal, often becoming erumpent; asci 8-spored; spores elliptical or subelliptical, hyaline, simple. Distinguished from *Charonectria* by the simple spores.

Type species: *Hyponectria Buxi* (DC.) Sacc.

Spores 5–6 × 1.5–2 mic., on stems of *Opuntia* sp.	1. *H. Cacti.*
Spores 10 × 2–2.5 mic., on herbaceous stems.	2. *H. dakotensis.*

1. **Hyponectria Cacti** (Ellis & Everh.)

Nectriella Cacti Ellis & Everh. Jour. Myc. 8: 66. 1902.

Perithecia minute, scattered, subepidermal, globose or subglobose, expanded above the epidermis into a disc-like ostiolum, perithecia red, with ostiolum lighter, whitish (in preserved specimens), about 200 mic. in diameter; asci cylindrical to clavate, 8-spored, 40–50 × 3–4 mic.; spores 2-seriate, simple, hyaline, straight or curved, 5–6 × 1.5–2 mic.

On stems of *Opuntia* sp.

TYPE LOCALITY: Alabama.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Alabama, *Carver 584* (type).

2. **Hyponectria dakotensis** sp. nov.

Perithecia scattered or occasionally 2 or more in close contact, subepidermal, becoming more or less erumpent, long, covered

by the thin, whitish epidermis of the host, scattered over whitish patches on the substratum; ostiolum forming a disc-like expansion above the surface of the epidermis, with a distinct perforation in the center, slightly hairy, especially near the margin of the disc, where the hairs appear as a delicate fringe; perithecia 200 mic. in diameter; asci clavate, 8-spored, $30–45 \times 5$ mic.; spores mostly 2-seriate above, often 1-seriate below, fusoid, with usually 2 large oil-drops, and 1–2 smaller ones toward either end, $10 \times 2–2.5$ mic., paraphyses present, delicate.

On herbaceous stems (*Ambrosia trifida?*).

TYPE LOCALITY: Fargo, N. Dakota.

DISTRIBUTION: Known only from type locality.

The perithecia of the present species are so minute that they are easily overlooked and were first noted in connection with the study of other species of fungi. They are scattered over whitish patches on the surface of the substratum and although the substratum is whitened where the perithecia occur there is apparently no superficial mycelial growth. Two collections of the species were made by the writer in the same locality near Fargo.

The genus *Charonectria* Sacc. differs from the present genus in possessing septate instead of simple spores. The presence or absence of the septum in case of very small spores is sometimes difficult to determine and in the North Dakota specimen the spores which have two large oil-drops often appear to be septate but no definite septum could be made out. The genus *Charonectria* is also represented in North America by a single species which is quite different from the species here described, not only in the presence of septate spores but in the size of both plants and spores as well.

Nectria semenicola sp. nov.

Conidial phase consisting of a white mycelial growth which covers the substratum, finally heaping up at various points forming pinkish stomata; conidiophores erect, much branched, branches ascending perpendicularly, bearing at their summits, elliptical, hyaline conidia; conidia $5–7 \times 2–3$ mic., with 1–2 oil-drops.

Perithecia cespitose in small, dense clusters, with numerous scattered individuals; clusters confluent, often covering the most

of the exposed surface of the seed; individual perithecia nearly globose, with a minute, papilliform ostiolum, smooth or nearly so, 250 mic. in diameter, at first orange, fading in drying to golden-yellow or whitish; asci clavate, 40–50 mic. long, 8-spored; spores mostly 2-seriate or irregularly crowded, hyaline, 1-septate, a little constricted at the septum, 10–14 × 3–3.5 mic.

On partially decayed seeds of skunk-cabbage (*Spathyema foetida*).

TYPE LOCALITY: New York City.

DISTRIBUTION: Known only from type locality.

The perithecia and spores of this species do not differ materially from some of the species of the genus which occur on bark of various trees. However, the habitat, which is in itself interesting, and the peculiar appearance of the conidial phase seem to distinguish this form from any of the species examined.

A specimen collected in the propagating house of the New York Botanical Garden on beans which had been used for experimental purposes and allowed to partially decay corresponds so far as we can see with those occurring on the seeds of skunk-cabbage.

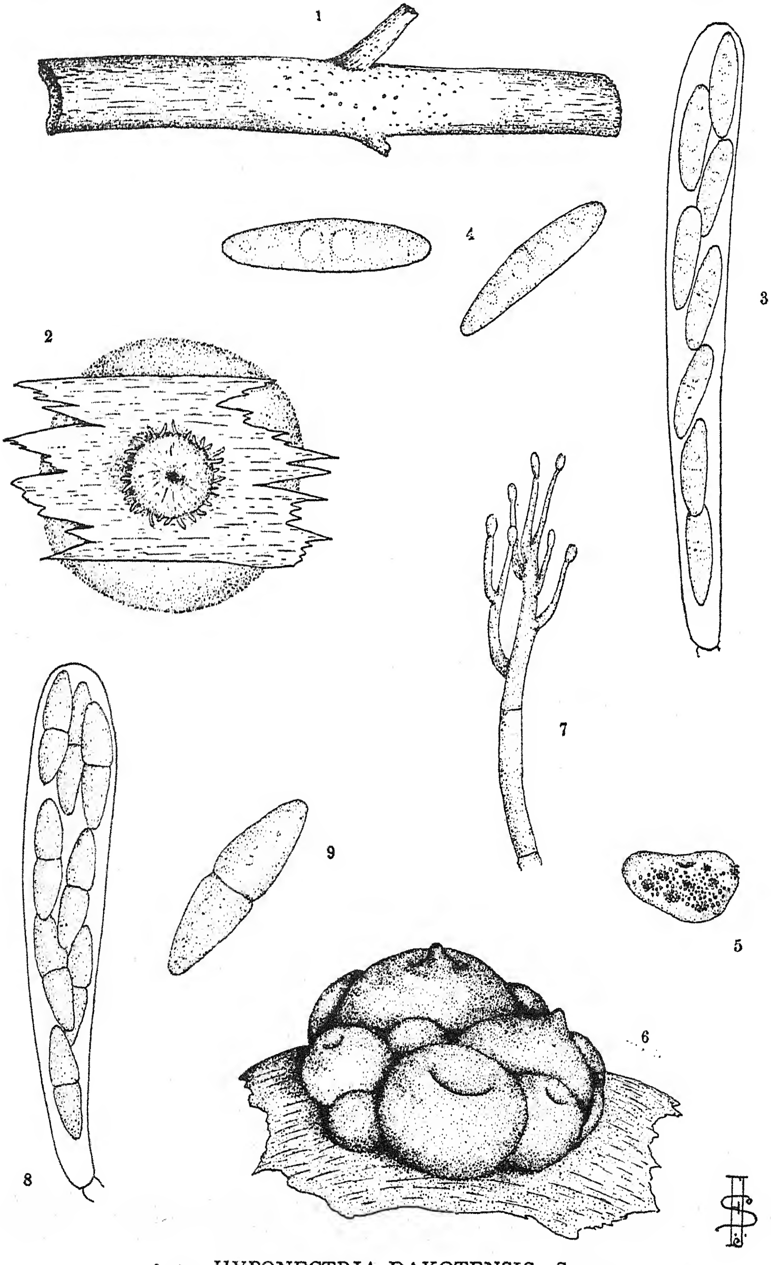
EXPLANATION OF PLATE II.

FIGS. 1–4. *Hyponectria dakotensis* sp. nov.

1. Habitat, showing plants natural size.
2. Ostiolum as it appears enlarged (surrounding epidermis diagrammatic).
3. Ascus with spores, × 2,000.
4. Two spores showing oil-drops within, × 2,500.

FIGS. 5–9. *Nectria semenicola* sp. nov.

5. Habitat, showing plants natural size.
6. Cluster of perithecia showing gross characters.
7. Conidiophore with conidia, × 400.
8. Ascus with spores, × 2,000.
9. A single spore, × 2,500.



1–4. HYPONECTRIA DAKOTENSIS Seaver

5–9. NECTRIA SEMENICOLA Seaver

A BACTERIAL DISEASE OF THE PEACH*

James B. Rorer

From time to time during the past five or six years peach growers in various sections of the country have called attention to a shot-hole disease of peach leaves which, in wet seasons at least, has caused a great deal of premature defoliation. In 1903 Mr. P. J. O'Gara, of the Bureau of Plant Industry, found it prevalent in Georgia and suggested that it was of bacterial origin. During the same season Clinton* observed a leaf-spot disease, evidently the same, in Connecticut, and noted it in his report for that year.†

It was again found in Georgia in 1905 by Mr. W. M. Scott, of the Department of Agriculture. In 1906, 1907, and also in the past season the writer, who undertook a somewhat detailed study of the disease found it to be prevalent throughout the South and Middle West, and, in those sections at least, it is the commonest shot-hole disease of peach leaves, the Cercospora leaf-spot being but rarely met with. That a bacterium caused the disease was proved by inoculation experiments. A bacterial disease of peach twigs and of the fruit was also found, and it seems probable that they, as well as the leaf-spot, are caused by the organism in question.

The form occurring on the leaves is by far the commonest and most wide spread. It causes somewhat angular, purplish-brown spots ⅛ to ¼ inch in diameter which, when infections have been numerous, coalesce so that quite large areas of the leaf may be involved. The diseased tissues soon fall out, giving a shot-hole effect. Leaves which are at all badly affected soon drop to the ground, so that the trees may become prematurely defoliated. This is especially true in orchards which have not been well pruned and cultivated.

In August, 1906, very small spots from fresh leaves were

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* Paper read at the meeting of Section G, A. A. A. S., Baltimore, 1908.

† Rep. Conn. Agric. Exp. Sta. 26: 337. 1903.

cut out, thoroughly washed, and then mashed up in sterile water, from which, by the poured-plate method, a yellow motile organism was isolated. Many of the plates proved to be pure cultures containing sometimes 100 or 200 colonies.

During the summer of 1907, a series of successful inoculations with this bacterium was made at Bentonville, Arkansas. Sterile water was added to pure cultures on slant agar five days old and with a sterile needle the bacterial growth was loosened from the surface of the medium and thoroughly mixed with the water. This liquid, containing bacteria in great numbers, was diluted a little and then sprayed with an atomizer on young Elberta peach leaves. This variety was chosen because it is naturally quite susceptible to the disease. Three sets of inoculations were made on different days and on different trees. From thirty to forty leaves were involved in each spraying. About an equal number of leaves on adjacent trees were sprayed with sterile water alone to serve as a check. The inoculations were made on June 25, 26 and 28. The trees inoculated on the two earlier dates were examined on July 15. From four to six spots of the characteristic appearance were found on most of the leaves which had been sprayed with the bacteria-bearing fluid, while the leaves sprayed with sterile water showed no spots at all. The leaves inoculated on June 28 were examined on July 20, and, as in the previous cases, the leaves which had been sprayed with the bacteria showed spots, three or four to a leaf, while the checks remained free. Sections of these spots on the inoculated leaves, when examined under the microscope, showed the characteristic cavities filled with bacteria and plates poured from the smallest spots were practically pure cultures of one organism, the motile yellow bacterium with which the inoculations had been made. Although in no case were the spots on the leaves as numerous as one might expect considering the large number of bacteria in the fluid used, the fewness of the spots may be accounted for by the fact that the weather conditions at the time were very unfavorable, there being scarcely any rainfall and but little dew, and no attempt whatever was made to keep the leaves moist after the inoculations were made. From these ex-

periments the conclusion may be drawn that this disease of peach leaves is caused by the yellow bacterium.

The disease as it occurs on the twigs was first observed by the writer at Siloam Springs, Arkansas, in 1907. It kills the bark of young shoots, forming purplish-black, slightly sunken areas usually $\frac{1}{8}$ to $\frac{3}{16}$ inch wide which may extend for two or three inches along the stem or even girdle it. At times the whole end of a shoot may be killed. The infections as a rule seem to take place at a leaf scar. The disease was found again last year in an orchard at Bentonville, Arkansas. In each case it was closely associated with the bacterial leaf-spot; in fact many of the diseased twigs had already been defoliated. Sections through the smallest spots showed that bacteria were present in enormous quantities in cavities in the bast tissue, and by the poured-plate method a yellow bacterium was isolated from these spots. The growth of this organism in various media, such as beef, rice and corn-meal agar and on potato cylinders, is similar to that of the organism isolated from the leaf-spots and the two organisms are evidently the same. No attempt has yet been made to produce the disease on the twigs by inoculation.

The disease as it occurs on the fruit is quite striking and exceedingly characteristic. It was found in two orchards at Bentonville during the past season. It causes a very small purplish spot over which the skin soon cracks either in a straight or angular way. The individual spots are scarcely ever much over $\frac{1}{16}$ of an inch in diameter but are usually very numerous (as many as 250 have been counted on one side of a peach), so that the cracks may become continuous and extend for an inch or more. Numerous sections through even the smallest of these spots showed that bacteria were present in enormous quantities and were evidently the cause of the trouble. Attempts to get pure cultures of the organism were not successful because of the cracks and the small size of the spots which made it impossible to sterilize the outside of the peach without killing the parasite, and when plates were poured from spots which had not been sterilized on the outside they became completely overrun with rapidly growing saprophytes. The reasons for assuming that

the organism isolated from the leaf-spot and the stem-spot is also responsible for this fruit-spot will be pointed out later.

As to the identity of the organism causing the leaf-spots there does not seem to be much doubt. Soon after the peach leaf-spots were first found, Dr. Erwin Smith suggested to the writer that *Bacterium pruni,* the organism causing the bacterial black-spot of plums and a plum leaf-spot, was the cause, and though this as yet has not been completely proved, all the work that has been done points to the truth of that suggestion. In the first place the hosts are closely related and have other diseases in common; then too the microscopic and macroscopic appearance of the peach leaf-spots is identical with that of the bacterial plum leaf-spots. For the past three months the organism isolated originally from peach leaf-spots and *Bacterium pruni* isolated from plum spots, have been grown side by side in different culture media, such as beef bouillon, nitrate bouillon, Uschinsky and Dunham solution, gelatin, beef agar, milk, litmus milk, and potato cylinders and in all the cultural characteristics are exactly the same. Finally, by inoculating with *Bacterium pruni,* spots may be produced on peach leaves similar in all respects to those resulting from natural infection and from artificial infection with the organism isolated from natural infection spots on the peach.* The only thing necessary to complete the chain is to produce the plum spots with the organism isolated from the peach leaf-spot.

Though the twig-spots have not yet been produced by inoculation the organism isolated from them has all the cultural characteristics of the leaf-spot organism so that it also may be considered to be *Bacterium pruni.*

As the fruit-spot was not discovered until the end of the peach season last year but little work has been done on it. Attention is called to it here because of its bacterial nature and its very characteristic appearance. It has not been produced by inoculation nor has the organism been isolated, but the spots

* In a paper entitled "Occurrence of *Bacterium pruni* on Peach Leaves," read before the Society of American Bacteriologists at the Baltimore meeting, Dr. Erwin F. Smith reported the results of inoculations with *Bacterium pruni* on peach leaves made in 1907–1908, which agree in every respect with those obtained by the writer.

are so strikingly similar in both microscopic and macroscopic appearance to the young bacterial spots on the plum, especially those resulting from late infections, that it may be safely assumed that *Bacterium pruni* is the cause of this disease also.

The writer is planning to continue the investigation of these diseases through another season in order to establish more definitely their relationship.

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WASHINGTON, D. C.

THE PROBLEMS OF NORTH AMERICAN LICHENOLOGY

BRUCE FINK.

Several years ago the writer gave an address, later published,* covering certain phases of the subject of this paper, and he will now attempt to cover other ground. Many of the lichenological problems which should claim some attention from American botanists are not strictly North American problems, but some of these must be considered as well as the problems that are more strictly American. Of problems which may be regarded more strictly ours as American botanists, we wish to consider several, without attempting to include all.

A matter of some importance is popularizing American lichenology without degrading it. This has been done for some other portions of our flora, and can be done for the lichens. However, the task is not an easy one, but requires the best effort of a trained botanist, who is at the same time a student of lichens. Such a work, with profusion of illustration and workable keys to families, genera, and species, would no doubt bring to lichenology many workers who could aid in making the flora of various regions known.

Careful studies are needed over our whole territory, in order that the lichens may be collected and become well known. Nor is it collecting alone that is wanted, good as that is, but we need workers who will both collect and study. Many have contributed largely by collecting and sending their collections to lichenists for study. Some of these persons have come to possess a fairly good knowledge of lichenology and have become sharp-eyed collectors. Nevertheless, the best collecting is done by persons who are making careful studies of the materials collected. One may, perhaps, be able to collect the larger and more easily distinguishable foliose or fruticose lichens without

* Fink, Bruce. Two Centuries of North American Lichenology. Proc. Iowa Acad. Sci. 11: 11–38. *pl. 1.* 1904.

so much careful microscopic work, but no one can hope to contribute largely to a knowledge of our crustose lichens, which are least known, without being a careful student of his material as well as a collector.

The thing most needed, however, for the systematist, is a reliable manual of North American lichens and monographs of the genera. The need of a manual is so great, that there would be ample excuse for one who might be inclined to undertake such a work to begin at once; but, in the present state of North American lichenology, the task could be only very imperfectly performed at best. There is not a monograph of a single genus of lichens for North America, though some monographs by Europeans treat our species in a very imperfect way. Nor can the monograph of the genus *Arthonia* by Henry Willey† be considered as more than a compilation. There is here a rich field for the trained systematist who has access to the centers of botanical activity, large herbaria and libraries. Without these facilities creditable work in systematic lichenology is no longer possible, whatever may be the ability and training of the worker.

Another matter of prime importance is the accumulation of a knowledge regarding the literature of American lichenology. There should be definite historical statement, a list of all species described as new from our territory, a list of all first mention of species from North America, a bibliography as complete as can be made, and even a compilation of all lists of lichens published as occurring on American territory. It is known to many workers that the writer has been at work on the bibliography and the listing of new species for several years. However, though the titles now number somewhat less than six hundred, every effort to close the work for publication has resulted in finding it too incomplete for that purpose. The larger and less interesting and useful task of compiling all lists published has not been attempted, though the writer is of the opinion that every worker in any field of botanical taxonomy should have such lists at hand, however imperfect the determinations may be upon which the lists rest, and however little confidence may be placed in

† Willey, Henry. A Synopsis of the Genus Arthonia. i–vi and 1–62. New Bedford, Mass., E. Anthony & Sons. 1890.

them without seeing the specimens listed. Finally, in default of a new manual of North American lichens, a compilation of descriptions of post-Tuckermanian new species would be well worth while. This, in turn, can be done only after one has at hand as reliable a bibliography as can be made.

A labor less distinctly American is that of typifying lichen genera. This problem may become distinctly one for Americans through failure of European lichenists to attack it. Our present knowledge of lichen genera is far from complete. Recent attempts to typify genera of American lichens has proven to the writer that all lists of lichen genera, Krempelhuber's* not excepted, fall far short of being complete. Krempelhuber gives approximately 750 lichen genera, and there are fully 250 more, some of which he either ignored in his compilation or did not know, while others have been proposed since 1870. An approximately complete list of lichen genera is to be had only by working over a vast amount of botanical literature, searching in obscure places as well as in publications better known. This involves an enormous amount of difficult literary work, besides thousands of critical examinations of specimens. Some examples of difficulties may be drawn from the writer's attempts to typify our lichen genera. However, before giving these instances of difficulties arising in attempts to typify genera according to the first species rule, the writer wishes to disavow any settled conviction on his part that this is the best method, nor does he care to be interpreted as being certain that it is best to abandon well established generic names in the interests of priority; he prefers to reserve judgment for the present. The illustrations are as follows:

Type species, *Amphiloma elegans* (Link) Fr. Körb. Syst. Lich. 110. 1855. But this is our *Placodium elegans*, and the name *Amphiloma* is invalid. Type species, *Pyrenula verrucosa* Ach. Lich. Univ. 314. *pl. 15. f. 1.* 1810. But this plant is a *Verrucaria*, and *Pyrenula* would be invalid, were not *Verrucaria*, in our present conception of the genus, invalid. But we have as

* Krempelhuber, A. von. Geschichte und Litteratur der Lichenologie 1: i–xv. 1–616. 1867; 2: i–viii. 1–776. 1869; 3: i–xvi. 1–261. 1872. München, C. Wolf & Sohn.

type species for *Verrucaria, Lichen ericetorum* L. Sp. Pl. **2**: 1141. 1753, which is, according to Wainio (Soc. Faun. Fl. Fenn. **14**: 20. 1888), identical with our *Icmadophila* (*Bæomyces*) *æruginosa,* which is in turn the type of *Ichmadophila* Ehrh. Beitr. Naturk. 4: 147. 1789. Among foliose and fruticose genera we have *Physica fastigiata* (Pers.) Ach. Lich. Suec. Prod. 175, 255. 1798. = *Ramalina calicaris* (L.) Fr.; *Physcia* thus taking precedence over *Ramalina,* being the older name, though final disposition must as in all other similar instances await typification of all lichen genera. Again, the type of the well established genus *Rinodina* is *Rinodina atra* (Huds.) S. F. Gray, Nat. Arr. Brit. Pl. **1**: 448. 1821 (= *Lecanora atra*). *Lecanora,* being older, would replace *Rinodina* in strict application of the rules of priority, but examination of the writings of Acharius shows that he has placed *Gyalecta, Lecanora,* and *Parmelia* in a tangle by citing for types of all three genera lichens belonging to *Lecanora,* according to the modern conception of that genus, based upon the author's type. Lack of space forbids a discussion of the status of the three genera; and further instances of difficulties met in typifying lichen genera without full knowledge of all the genera would be out of place here.

The work of typifying lichen species is quite as important. We can not arrive at anything like finality regarding our species until the types, largely in European herbaria, have been examined. We have more or less of synonymy, largely handed on from author to author, but synonymy given by any author may be regarded as unreliable, unless based upon the examination of type specimens by him. Indeed, the sooner the practice of copying citations and long lists of synonyms from other authors is abandoned the better. An author may be pardoned for citing the first name of a species, since this seems necessary, but he had better stop there unless he has seen the type specimens upon which his synonymy rests.

In conclusion, some problems not distinctively American may be discussed briefly. First among these we shall consider lichen ecology. Dr. H. C. Cowles* has well said: "The speaker has

* Cowles, H. C. The Work of the Year 1907 in Ecology. Science **19** (N. S.): 879–925. 1904.

long felt that lichens are among the most interesting of plants ecologically, because they are so closely related to the unmodified physical environment." A few papers on lichen ecology have appeared in our country, and the writer has noted European papers bearing ecological titles, not to include many others which have an indirect bearing, but which may none the less prove more valuable to the ecologist in the long run. The American work is but a beginning, and much of it surely will not endure the testing of ecology now in progress, but the field is a most fruitful and inviting one and should attract some competent workers.

We can only mention some other problems not strictly American. A proper classification of lichens must rest upon a better knowledge of general morphology of these plants than we now possess, a sufficient understanding of the symbionts and their phylogeny, a more thorough study of the physiological relationship of the symbionts and a more widely extended and more minute study of the sexual reproductive tracts in these plants.

OXFORD, OHIO, January 24, 1909.

NEWS AND NOTES

A recently published list of registered investigators at the New York Botanical Garden during the first ten years of its history shows that nearly 25 per cent. of these investigators devoted all or most of their time while in residence to the study of fungi.

A summary of botanical work at the New York Agricultural Experiment Station from 1882 to 1907, by F. C. Stewart, indicates the great advances made in plant pathology since the discovery of bordeaux mixture in France and the establishment of agricultural experiment stations throughout the United States.

Dr. and Mrs. W. A. Murrill returned from Jamaica, January 27, with a large collection of fleshy fungi. Collections were made at fourteen different points on the island, from sea level to elevations of over six thousand feet. Copious notes and colored illustrations were obtained from specimens in a fresh condition.

The Journal of the New York Botanical Garden for December contains an article of several pages on the edible fungi of Bronx Park, illustrated by two plates containing twelve figures, five of which are colored.

Nine parts of North American Flora have been issued to date, four of which are mycological in character. Vol. 7, part 1, contains descriptions of the families Ustilaginaceae and Tilletiaceae, by G. P. Clinton; vol. 7, part 2, the Coleosporiaceae, Uredinaceae and Aecidiaceae (pars), by J. C. Arthur; and vol. 9, parts 1 and 2, the Polyporaceae, by W. A. Murrill.

An important addition to the literature of the fleshy fungi has recently been made by Miss Gertrude Burlingham, now of the Eastern High School, Brooklyn, who was a student at the Garden and Columbia University from 1905 to 1908, during

which time she made an exhaustive study of the Lactariae, or gill-fungi having a milky juice. The results of her studies appeared May 26 as a memoir of the Torrey Botanical Club (14: 1–109. *f. 1–15.* 1908). The descriptions and notes are very complete, and the illustrations, from photographs by the author, are excellent. A feature of great value to collectors is a condensed description of each species when fresh with distinguishing characters to be used in the field. Seventy-one species are recognized in the United States, six of these being described as new.

The Bulletin of the University of Wisconsin, issued in August, 1908, contains the results of a series of infection experiments with *Erysiphe Chicoracearum* D.C. which were obtained by Dr. G. M. Reed. It has been previously shown that among the mildews a single morphological species may consist of several physiologically distinct forms limited in their occurrence to a single host or several closely related hosts. As a result of the experiments on the above named powdery mildew, seventeen species and varieties of cucurbits are added to the list of the host plants of this fungus. It is also shown that the biologic form of *E. Chicoracearum* D.C. occurring on so many cucurbits is not confined to the species of this family. The results of the many inoculation experiments are carefully tabulated in this paper, furnishing a reliable basis for the conclusions drawn by the author. The conclusions of various writers in regard to physiological forms of parasitic fungi are reviewed. It is supposed that these physiological forms represent the first stages in the evolution of species morphologically distinct.

The October number of Annales Mycologici contains a monograph of the North American Geoglossaceae by Dr. E. J. Durand, of Cornell University. The author recognizes for this family of discomycetous fungi in North America eleven genera, forty-two species and two varieties. In addition to this number, eleven species have been reported from North America which are not well known. One new genus and nine new species are described.

The paper is accompanied by eighteen plates, containing, in all, two hundred and twenty-two figures, consisting of camera lucida drawings, photographs and microphotographs illustrating characters which are of importance in the diagnosis of the various genera and species. This monograph represents a very thorough piece of work, since practically all of the existing types of the species described have been examined, and it therefore furnishes a reliable basis for future work on this attractive group of plants in which the flora of North America is said to be especially rich.

At a meeting of plant pathologists called at Baltimore, December 30, 1908, in connection with the meeting of the American Association for the Advancement of Science, Prof. A. D. Selby, of the Ohio Experiment Station, was elected temporary chairman, and Mr. Donald Reddick, temporary secretary. The temporary committee, appointed at Washington, December 15, consisting of C. L. Shear, Donald Reddick and W. A. Orton, presented its report recommending that an organization of American plant pathologists be perfected.

The report of the committee was accepted and temporary organization was effected by the unanimous election of the following officers:

President—Professor L. R. Jones, Vermont Agricultural Experiment Station.

Vice-President—Professor A. D. Selby, Ohio Agricultural Experiment Station.

Secretary-Treasurer—Dr. C. L. Shear, U. S. Department of Agriculture.

Councilmen—Professor J. B. S. Norton, Maryland Agricultural Experiment Station; Professor B. M. Duggar, Cornell University Agricultural Experiment Station.

The five officers elected form a council which is to consider and make recommendations in regard to all questions relating to the permanent organization, policy and affiliation of the society

The next meeting will be called at such time and place as may be decided by the council.

It is well known that practically all of the chestnut trees in and about New York City have been killed within the past few years by the chestnut canker, *Diaporthe parasitica;* but the number of trees destroyed has been only very roughly estimated. Through the efforts, however, of Mr. J. J. Levison, arboriculturist of the parks of Brooklyn, who has made a careful survey of Forest Park, it is now known that 16,695 chestnut trees were killed in the 350 acres of woodland in this park alone. Of this number, about 9,000 were between eight and twelve inches in diameter, and the remaining 7,000 or more were of larger size.

ILLUSTRATIONS OF FUNGI

MYCOLOGIA

VOL. I MARCH, 1909 NO. 2

ILLUSTRATIONS OF FUNGI—II

WILLIAM A. MURRILL

The species shown on the accompanying plate are all edible and abundant, most of them occurring on lawns or in pastures throughout this country and Europe.

Agaricus campestris L.

COMMON MUSHROOM

Plate 3. Figure 1. × ½

Pileus 5–9 cm. broad, convex to expanded, dry, silky and whitish or floccose-squamulose and light reddish-brown, the color being chiefly in the scales; flesh white, thick, solid, of mild flavor, sometimes becoming reddish when broken; gills free, rounded behind, ventricose, crowded, white when young, becoming salmon-pink, and finally purplish-brown or blackish; spores ellipsoid, smooth, dark-brown, 10–12 μ long; ring delicate, inconspicuous, formed from a thin, white veil, which covers the gills in their younger stages; stem smooth, white, cylindrical, nearly equal, stuffed within, 3–6 cm. long, 1.5–2 cm. thick.

The common mushroom occurs in low grass on meadows or on rich, moist upland pastures, being common after rains from August to October in this latitude. The "spawn," or vegetative portion, is hidden in the soil and feeds upon the dead organic matter found therein. In the cultivation of this species, bricks of spawn are planted in suitable soil and the conditions of growth attended to with great care. This is the mushroom usually found in market, either in the fresh stage or in cans. Most persons

[MYCOLOGIA for January, 1909 (1: 1–36), was issued 27 F 1909.]

who collect fungi for food in the fields limit themselves to this one species.

Pluteus cervinus (Schaeff.) Fries

FAWN-COLORED PLUTEUS

Plate 3. Figure 2. $\times \frac{1}{2}$

Pileus 6–10 cm. broad, rather thin and fragile, bell-shaped to expanded, smooth or slightly radiate-fibrillose, avellaneous to subfuliginous, rarely white, sometimes streaked; flesh white, almost tasteless; gills free, broad, white when young, becoming salmon-pink; spores broadly ellipsoid, smooth, flesh-colored, $6\text{–}8 \times 5\text{–}6\ \mu$; cystidia ellipsoid, stout, thick-walled, hyaline, forked at the tip; stem equal or enlarged at the base, white above, more like the cap below, usually glabrous, nearly solid, brittle, 8–15 cm. long.

This edible species occurs quite commonly in open woods about stumps and on decaying wood of various kinds from June to November. The illustrations were made from specimens collected on an old sawdust pile in October, and they show the effect of the cold.

Coprinus comatus (Muell.) Fries

SHAGGY-MANE

Plate 3. Figure 3. $\times \frac{1}{2}$

Pileus at first oblong, subcylindrical, 4–6 cm. in diameter, expanding and deliquescing with age; surface shaggy, white, with yellowish or brownish scales, tinged with lilac in places, grayish-black on the margin, blackening with age; flesh white, tender, of nutty flavor; gills crowded, white when young, soon changing to pink, then to black, and finally melting away into an inky fluid; spores ellipsoid, black, $13\text{–}16\ \mu$; ring white, small, movable or slightly adhering, often falling away at an early stage; stem slender, smooth, white, hollow, 7–12 cm. long.

The shaggy-mane is a very conspicuous object on lawns in autumn, although it is not so abundant as might be desired. On account of its peculiar shape and decided colors, a single specimen rarely fails to attract attention. It is considered one of the very best of the edible fungi, and is often eaten raw by foreigners.

Coprinus atramentarius (Bull.) Fries

COMMON INK-CAP

Plate 3. Figure 4. $\times \frac{2}{3}$

Pileus 3–6 cm. broad, ovoid to campanulate, finally expanding and deliquescing, glabrous or slightly scaly, especially on the disk, grayish or brownish, often with a yellowish tint, blackening with age; flesh white, quickly deliquescing; gills crowded, white when young, soon becoming black and dissolving; spores ellipsoid, black, 7–10 μ; ring sometimes apparent near the base of the stem as an indistinct line; stem slender, smooth, white, hollow, 5–10 cm. long.

This species is quite common in rich soil on lawns and elsewhere during late summer and autumn. As it appears in close clusters, it may be obtained in greater abundance than the shaggy-mane. Owing to its deliquescent character, it must be cooked very soon after it is collected.

Coprinus micaceus (Bull.) Fries

GLISTENING INK-CAP

Plate 3. Figure 5. $\times \frac{2}{3}$

Pileus thin, ovoid to campanulate, 1.5–2.5 cm. in diameter, soon expanding and becoming discolored; surface striate, tawny-yellow or tan, yellowish-orange on the umbo, usually covered with minute, glistening scales when young; flesh thin, white, of nutty flavor, quickly deliquescing in wet weather; gills white when young, soon becoming purplish-brown and finally black; spores ellipsoid, brown, 6–7 μ; stem white, slender, fragile, hollow, 3–10 cm. long.

The glistening ink-cap grows abundantly in dense clusters about stumps and dead trunks, especially of elm, and appears very early in the season, developing after rains from April to November. It is of small size, but delicate in flavor and easily prepared in a variety of ways. The plants should be gathered young and cooked within a few hours.

Collybia velutipes (Curt.) Fries

VELVET-STEMMED COLLYBIA

Plate 3. Figure 6. $\times \frac{2}{3}$

Pileus 2–4 cm. broad, thin, convex to nearly plane; surface glabrous, viscid, tawny or reddish-yellow; flesh white, not fragile,

agreeable in flavor; gills broad, slightly adnexed, rounded behind, white or faintly yellowish; spores narrowly ellipsoid, white, $7–9 \times 4\ \mu$; stem slender, 2–8 cm. long, cartilaginous, hollow or nearly so, light-colored above, brown below, with a conspicuous coat of velvety hairs.

This species is remarkable for its late appearance, being often collected during the winter. It grows in clusters on stumps and dead trunks near the ground, and is easily recognized by its viscid, yellowish cap and velvety stem.

THE HYPOCREALES OF NORTH AMERICA—I

Fred J. Seaver

(With Plates 4 and 5, Containing 33 Figures)

The Hypocreales might be briefly defined as the bright-colored sphaeriaceous fungi, the bright color being the most conspicuous character of this order, the early described members of which were included in the genus *Sphaeria*. In addition to color, the plants of the order are characterized by membranaceous perithecia and fleshy stromata, when the latter are present, as opposed to the carbonaceous perithecia and stromata and, usually, the black color of the true pyrenomycetes. While no one of these characters is sufficient in itself, taken together they are quite definitive of the order, which appears to be a well-marked natural group.

The plants of this order exhibit in their life-histories two phases, the conidial and ascigerous, the so-called imperfect fungi representing the conidial phase of many of the species. In no group of fungi is there more need of a close and critical study of the life-histories of its individual members than in the one now under consideration. In a few cases this has been done, with the result that some of the species have been found to be of extreme economic importance in their relation to plant diseases, and doubtless the same fact will be discovered with reference to other species when critical work of this kind is extended to those forms. While the conidial phase in a part of the order is obscure, in others it is often profuse, forming a distinct fleshy or cottony stroma, on which are produced first conidiophores and conidia, and later perithecia, the latter containing the asci and spores. The characters of the conidiophores and conidia are very variable and will furnish much valuable information as to the natural relationship of the various members when the life-histories of the species are better known. In one group, which is here treated as a tribe, the stromata develop from a sclerotium, the latter term

being used in its broader sense to include any fungous growth which produces its ascigerous stage only after a period of rest.

The order contains approximately two hundred species in the region covered in the present work, which are distributed throughout temperate and tropical America. While many species occur throughout North America, others are found only in the tropics.

The classification of the order is a question concerning which there are many different views. A single family is usually recognized, and this is divided by Lindau* into six subfamilies. The system adopted in the present monograph corresponds in many respects with that proposed by Lindau, but differs in that perithecial and stromatic characters are considered of primary importance in the separation of the order into families and tribes, while spore characters (color, form, septation, etc.) are retained as of generic or specific importance only.

The genus *Nectria* as commonly considered includes both stromatic and non-stromatic species. This difference was recognized by Fries, and has continued to be recognized as a sectional or subgeneric character up to the present time. Dr. M. C. Cooke went a step further and raised Saccardo's subgenus *Dialonectria* to generic rank, although this is not commonly so recognized. The separation of this genus on the presence or absence of a stroma is here maintained, but since the type of the genus *Nectria* falls among the non-stromatic species, the name *Nectria* is retained for those forms, while a new name is proposed for the stromatic species. In recent times, other genera, such as *Ophionectria* with filiform spores and *Calonectria* with many-septate spores, have been segregated from the old genus and a separation of *Nectria* on the presence or absence of a stroma necessitates a similar separation of other genera in which stromatic and non-stromatic species have been associated. The free (non-stromatic) forms of nectriaceous plants are here brought together in the tribe Nectrieae.

With the stromatic and perithecial characters as a basis, the order consists of two well-defined groups, which are here treated as families, each of which is in turn divided into two tribes. The details of this classification are contained in the synopsis given below.

* E. & P. Nat. Pfl. 1[1]: 346. 1897.

Order HYPOCREALES

Perithecia globose, ovate, conical, cylindrical, fusoid, or flask-shaped, free on the substratum (occasionally subepidermal) or united by a common matrix, varying from a cottony subiculum to a distinct fleshy stroma, bright-colored, white, yellow, red, brown, violet, but never entirely black, except in extreme age, opening by an ostiolum; perithecial wall membranaceous or submembranaceous, never carbonaceous; stroma when present bright-colored and soft, fleshy or cottony, and varying in size from 1–2 mm. to several cm. in diameter, patellate or effused, with the perithecia entirely superficial or partially to entirely immersed; asci cylindrical, clavate, or subovoid, mostly 4–8-spored but often becoming 16-spored by the separation of each original spore into 2 globose or subglobose cells; spores simple or compound, hyaline or colored, globose to filiform.

Conidiophores and conidia very variable.

Stroma wanting, or when present, with the perithecia entirely superficial, usually in cespitose clusters. 1. NECTRIACEAE.

Stroma or stromatic base always present and forming a conspicuous matrix in which the perithecia are partially to entirely immersed, rarely subsuperficial especially in aged specimens. 2. HYPOCREACEAE.

Family 1. NECTRIACEAE

Perithecia entirely free on the substratum (occasionally subepidermal), or seated on a fleshy or tubercular stroma, but when the latter is present, perithecia always superficial, usually in cespitose clusters; stroma often obscured at maturity by the perithecia and occasionally becoming obsolete in aged specimens, but in such cases its presence is indicated by the densely cespitose clusters of perithecia.

Stroma and stromatic base entirely wanting; perithecia free on the substratum, scattered or crowded, occasionally subepidermal. 1. NECTRIEAE.

Stroma or stromatic base always present; but often obscured at maturity by the perithecia and occasionally disappearing in weathered specimens but its presence indicated by the densely cespitose clusters of perithecia. 2. CREONECTRIEAE.

Tribe I. NECTRIEAE

Perithecia free (without stroma) and occurring singly but often gregarious and occasionally more or less crowded on the surface of the substratum, or formed beneath the epidermis and becoming erumpent-superficial, smooth, verrucose, or clothed with deciduous mycelial threads or well-developed hairs; asci cylindrical to clavate or subovoid, 4–8-spored; spores simple or compound, globose to filiform, hyaline or colored; conidial phase never forming a stroma.

Spores hyaline.	
Perithecia subepidermal, becoming erumpent-superficial.	
Spores simple.	1. HYPONECTRIA.
Spores septate.	2. NECTRIELLA.
Perithecia superficial on the substratum.	
Spores simple.	
Spores appendiculate; perithecia beaked.	3. ELEUTHROMYCES.
Spores without appendages; perithecia not beaked.	4. PSEUDONECTRIA.
Spores compound, 1–many-septate.	
Spores 1-septate.	5. NECTRIA.
Spores more than 1-septate.	
Perithecia light-colored, yellow or red.	
Spores elliptical to fusiform.	6. CALONECTRIA.
Spores filiform or subfiliform.	7. OPHIONECTRIA.
Perithecia dark-colored, blue.	8. GIBBERELLA.*
Spores dark-colored, brown or blackish.	
Spores simple.	
Spores subglobose, rough; perithecia subglobose.	9. NEOCOSMOSPORA.
Spores elliptical, smooth; perithecia flask-shaped.	10. MELANOSPORA.
Spores compound, 1-septate.	11. LETENDRAEA.

1. HYPONECTRIA Sacc. Michelia 1: 250. 1878

Perithecia globose or subglobose, subepidermal, often becoming erumpent; asci 8-spored; spores elliptical or subelliptical, hyaline, simple. Distinguished from *Nectriella* by the simple spores.

Type species: *Sphaeria Buxi* DC.

Spores 5–6 × 1.5–2 mic., on stems of *Opuntia* sp.	1. *H. Cacti.*
Spores 10 × 2–2.5 mic., on herbaceous stems.	2. *H. dakotensis.*

* See Creonectrieae.

1. HYPONECTRIA CACTI (Ellis & Everh.) Seaver, Mycologia 1: 20. 1909

Nectriella Cacti Ellis & Everh. Jour. Myc. 8: 66. 1902.

Perithecia minute, scattered, subepidermal, globose or subglobose, expanded above the epidermis into a disc-like ostiolum; perithecia red, with the ostiolum lighter, whitish (in preserved specimens), about 200 mic. in diameter; asci cylindrical or clavate, 8-spored, 40–50 × 3–4 mic.; spores 2-seriate, simple, hyaline, straight or curved, 5–6 × 1.5–2 mic.

On stems of *Opuntia* sp.

TYPE LOCALITY: Alabama.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Alabama, *Carver 584* (type).

2. HYPONECTRIA DAKOTENSIS Seaver, Mycologia 1: 20. 1909

Perithecia scattered or occasionally 2 or more in close contact, subepidermal, becoming more or less erumpent, long covered by the thin, whitish epidermis of the host, scattered over whitish patches on the substratum but with no apparent superficial mycelial growth; ostiolum forming a disc-like expansion above the surface of the epidermis with a distinct perforation in the center, slightly hairy, especially near the margin of the disc where the hairs appear as a delicate fringe; perithecia 200 mic. in diameter; asci clavate, 8-spored, 30–45 × 5 mic.; spores mostly 2-seriate above, often 1-seriate below, fusoid, with usually 2 large oil-drops, and 1–2 smaller ones toward either end, 10 × 2–2.5 mic.; paraphyses present, delicate (*pl. 4. f. 5*).

On herbaceous stems (*Ambrosia trifida*?).

TYPE LOCALITY: Fargo, N. Dakota.

DISTRIBUTION: Known only from type locality.

ILLUSTRATIONS: Mycologia 1: *pl. 2. f. 1–4*.

2. NECTRIELLA Fuckel, Symb. Myc. 175. 1869

Charonectria Sacc. Michelia 2: 72. 1880.

Perithecia globose or subglobose, entirely subepidermal or erumpent-superficial; asci 8-spored; spores hyaline, 1-septate.

Type species: *Nectriella Fuckelii* Nitsch.

Distinguished from *Hyponectria* by the compound spores.

Perithecia large, 400 mic. in diameter, pale red.	1. *N. Pedicularis.*
Perithecia small, 175–200 mic. in diameter, scarlet.	2. *N. peponum.*

1. **Nectriella Pedicularis** (Tracy & Earle)

Charonectria Pedicularis Tracy & Earle, Plantae Bakeriannae **1**: 26. 1901.

Scattered or gregarious, perithecia prominent but long covered by the thin epidermis, orbicular, at length subdepressed, bright-coral-red, smooth, soft, perforated by an obscure ostiolum, 400 mic. in diameter; asci numerous, cylindrical, with a stem-like base, 100 × 8 mic.; spores obliquely 1-seriate, hyaline, minutely granular within, 1-septate, subelliptical, ends acutish, 17 × 4 mic.

On dead stems of *Pedicularis crenulata*.

TYPE LOCALITY: Colorado.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Colorado, *Baker & Earle 230* (type).

The species is distinct in the large perithecia and spores.

2. **Nectriella peponum** (Berk. & Curt.)

Nectria peponum Berk. & Curt. Grevillea **4**: 16. 1875.

Nectria perpusilla Berk. & Curt.; Ravenel, Fungi Car. Exsicc. 51.

Perithecia scattered or gregarious, at first covered by the thin epidermis, becoming subsuperficial, but nestling in minute cavities in the substratum; ovoid, with a prominent, obtuse ostiolum, 175 × 200 mic., bright red, nearly scarlet, component cells of the perithecial wall distinct, 5 mic. in diameter; asci clavate, 35–40 × 5–6 mic., 8-spored; spores 1-septate, fusoid, hyaline, 10 × 4 mic.

On dead gourds.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: North Carolina, South Carolina.

EXSICCATI: Ravenel, Fungi Am. Exsicc. *338* and Fungi Car. Exsicc. *51*.

The species very closely resembles *Nectria sanguinea* (Bolton) Fries, but differs in its habitat and subhypodermal character, as well as in the color of the perithecia.

DOUBTFUL SPECIES

Nectria Galii Plow. & Hark. Bull. Cal. Acad. Sci. **1**: 26. 1884.

"Perithecia scattered, immersed then erumpent, obtuse, pale red; asci cylindrical, very delicate, mic. 60 × 5–8, sporidia eight, uniseriate, pale straw-colored, oblong-oval, with bluntly-pointed ends, mic. 10 × 5 on *Galium trifolium*."

"Mr. Phillips figures the sporidia as being uniseptate. I was unable to make out any septum, but the specimens examined may have been less mature than Mr. Phillips'."

The erumpent character of the perithecia of the above species and the 1-septate spores would place it in the genus *Nectriella.* No specimen of this species has been examined by the writer.

3. ELEUTHROMYCES Fuckel, Symb. Myc. 183. 1869

Perithecia free on the substratum, globose or subglobose, continued into a long neck, brownish or amber; substance soft; asci cylindrical, 4–8-spored; spores simple, fusiform, continued into a more or less bristle-like apex at either end.

Type species: *Eleuthromyces subulatus* Fuckel.

Distinguished from *Pseudonectria* by the flask-shaped perithecia and the appendiculate spores.

Perithecia large, 500 mic.–1 mm. high.	1. *E. subulatus.*
Perithecia small, 150–180 mic. high.	2. *E. Geoglossi.*

1. ELEUTHROMYCES SUBULATUS Fuckel, Symb. Myc. 183. 1869

?Clavaria brachiata Batsch, Elench. Fung. Cont. **1**: 234. 1786.
Sphaeria subulata Tode, Fungi Meckl. **2**: 44. 1791.
Isaria brachiata Schum. Pl. Saell. **2**: 443. 1803.
Sphaeronema subulatum Fries, Syst. Myc. **2**: 536. 1822.

Perithecia scattered or gregarious, subglobose below, tapering into a long neck, smooth or nearly so, yellowish or amber, 200–300 mic. in diameter at the base and 500 mic.–1 mm. high; asci cylindrical, fusoid, 8-spored, about 50 × 2–3 mic.; spores simple, elongated, averaging 4 × 2 mic., tapering into a bristle-like appendage of variable length at either end (*pl. 4. f. 12, 13*).

On partially decayed fungi.

TYPE LOCALITY: Europe.

DISTRIBUTION: Ontario.

ILLUSTRATIONS: Batsch, Elench. Fung. Cont. **1**: *pl. 28. f. 163;* Tode, Fungi Meckl. 2. *pl. 15. f. 117;* E. & P. Nat. Pfl. $\mathbf{1}^1$: *f. 238,* D–E; Nees, Syst. *pl. 43. f. 345,* B; Winter; Rab. Krypt. Fl. $\mathbf{1}^2$: 84. *f. 1–4.*

SPECIMENS EXAMINED: Ontario (no name).

Recognized by the very large perithecia.

2. **Eleuthromyces Geoglossi** (Ellis & Everh.)

Hypomyces Geoglossi Ellis & Everh. Jour. Myc. **2**: 73. 1886.
Peckiella Geoglossi Sacc. Syll. Fung. **9**: 944. 1891.

Perithecia superficial, closely gregarious, when fresh of a dirty greenish-yellow, when dry yellowish to amber, more or less furfuraceous, nearly globose, tapering into a rather long neck, 150 mic. in diameter at the base and 180 mic. high; asci slender, $50–75 \times 4–5$ mic., 8-spored; spores mostly 1-seriate, with the ends overlapping, hyaline, simple, tapering into an appendage-like extremity at either end, $10–12 \times 3–4$ mic. (*pl. 4. f. 10, 11*).

On *Geoglossum* sp.

TYPE LOCALITY: New Jersey.

DISTRIBUTION: New Jersey and New York.

SPECIMENS EXAMINED: New Jersey, *Ellis* (type); New York, *Seaver*.

Distinguished from the preceding by the much smaller perithecia as well as by the habitat.

The material collected by the writer in New York corresponds exactly with the type in spore characters but there is some difference in the color of the perithecia, those of the type being nearly black while those of our own collection are, with transmitted light, amber. As there are no notes on the color of the type specimen that difference might be due to drying.

This species was placed in the genus *Hypomyces* by Mr. Ellis but differs from the plants of this genus in the entire absence of stroma. Both the perithecial and spore characters strongly suggest the above genus.

4. **Pseudonectria** nom. nov.

Nectriella Sacc. Michelia **1**: 51. 1877.

Perithecia free on the substratum, globose to ovoid, bright colored, yellow, red, etc., smooth or minutely rough, soft, membranaceous; asci cylindrical, 8-spored; spores elliptical or subelliptical, simple, hyaline.

Type species: *Nectria Rousseliana* Montag.

Distinguished from *Nectria* by the simple spores.

1. **Pseudonectria sulphurata** (Ellis & Everh.)

Nectria sulphurata Ellis & Everh. Proc. Acad. Nat. Sci. Phil. 1890: 248. 1891.

Perithecia small, about 200 mic. in diameter, at first globose finally collapsing, sulphur-yellow-pruinose, becoming green with age; asci cylindrical, $50–60 \times 5–6$ mic., 8-spored; spores more or less crowded in the ascus, becoming partially 2-seriate, hyaline, allantoid, elongated, with ends obtuse, $7–12 \times 2–2.5$ mic.

On dead wood of *Populus tremuloides.*

TYPE LOCALITY: Sand Coulee, Montana.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Sand Coulee, Montana, *Anderson* (type).

Ellis states in the description of this species: "Perithecia . . . covered with a sulphur-yellow granulose-pruinose coat which finally disappears and leaves the perithecia black." The type specimens from which our description is drawn shows the perithecia to be of a beautiful aeruginous-green color. This fact not being mentioned in the original description, it is probable that this change of color comes about with age.

The specimen in the herbarium of Mr. Ellis was first referred to the genus *Nectriella* Sacc. and afterwards described as a *Nectria.* While in very small spores it is often difficult to determine the presence or absence of the septum this seems to be a non-septate form and is therefore placed in the genus to which it would properly belong.

This species is entirely different from *Nectria sulphurea* Ellis & Calk., which occurs on old fungi.

DOUBTFUL SPECIES

Nectria mycetophila Peck, Ann. Rep. N. Y. St. Mus. **26**: 85. 1874. *Nectriella mycetophila* (Peck) Sacc. Syll. Fung. **2**: 449. 1883.

"Perithecia crowded or scattered, minute, smooth, subglobose, pale yellow when young, then pinkish-ochre. Ostiola minute, papillate, distinct, darker colored. Asci subclavate. Sporidia oblong, simple, $12–13 \times 4$ mic."

On decaying fungi.

TYPE LOCALITY: New York.

DISTRIBUTION: Known only from type locality.

The above description is quoted from Mr. Peck as no material is available for examination.

Hypocrea perpusilla Montag. Hist. Phys. Polit. et Nat. l'ile de Cuba. Pl. Cell. 335. 1838. *Nectriella perpusilla* (Montag.) Sacc., Michelia 1: 51. 1877.

5. NECTRIA Fries, Summa Veg. Scand. 387 (in part). 1849

Nectria Fries, Syst. Orbs. Veg. 105 (as possible genus). 1825.
Dialonectria Sacc. (as subgenus) Syll. Fung. 2: 490. 1883.
Dialonectria (Sacc.) Cooke, Grevillea 12: 77. 1884.

Plants parasitic or saprophytic; perithecia superficial, entirely free, scattered or occasionally crowded, without stroma or common subiculum but individual perithecia often surrounded near the base by a scant mycelial growth, globose, ovate or conical in form; perithecial wall composed of distinct coarse cells or cell structure obscure, smooth, pruinose, furfuraceous, clothed with deciduous or well-developed, flexuose or bristly hairs; ostiola papilliform, obtuse, or obscure; color from whitish to yellow, orange or blood-red to reddish-purple, varying much in a given species according to age and conditions; asci cylindrical or clavate, mostly 8-spored; spores hyaline, 1-septate, elliptical, fusoid or fusiform, constricted or non-constricted at the septum; paraphyses often present but delicate and indistinct.

Type species: *Sphaeria Peziza* Tode.

The genus as treated here is used in its restricted sense to include only those forms in which stroma and a common subiculum are entirely wanting.

Perithecia pale, ranging in color from orange to sulphur-yellow or whitish.
- Perithecia large, 250–300 mic. in diameter (mostly 300).
  - Naked or nearly so (occasionally clothed with deciduous mycelial threads).
    - Saprophytic on various substrata.
      - Perithecia smooth or nearly so; spores elliptical. — 1. *N. Peziza.*
      - Perithecia covered with coarse granules; spores fusoid. — 2. *N. tremelloides.*
    - Parasitic on foliaceous lichens. — 3. *N. diplocarpa.*
  - Clothed with a dense covering of sulphur-yellow hairs. — 4. *N. flavociliata.*
- Perithecia small, 100–150 mic. in diameter (mostly less than 200).
  - Densely clothed with hyaline hairs (white to the naked eye).

Spores broad-elliptical. 5. *N. lactea.*
Spores very slender, allantoid (1–2 mic. broad).
Spores 5 × 2 mic. 6. *N. Rexiana.*
Spores 6–7 × 1.5–2 mic. 7. *N. squamulosa.*
Naked and smooth or only minutely rough.
Spores large, 15–22 mic. long.
Spores allantoid; plants parasitic on lichens. 8. *N. rubefaciens.*
Spores fusoid or fusiform, nearly straight; plants saprophytic
Spores broad-fusoid, 7 or more mic. broad.
On foliage of dead cedar; spores 15 × 7 mic. 9. *N. thujana.*
On bark; spores 18–22 × 7–10 mic. 10. *N. dispersa.*
Spores narrow-fusoid (4 mic. broad) or fusiform.
Spores narrow-fusoid, 18–22 × 4–5 mic. 11. *N. Eucalypti.*
Spores fusiform, 18–22 × 5–6 mic. 12. *N. Apocyni.*
Spores small, less than 14 mic. long (mostly 7–10).
Perithecia sulphur-yellow-pruinose; substratum yellow. 13. *N. sulphurea.*
Perithecia not sulphur-yellow-pruinose.
Perithecia pale, almost white, becoming subtruncate. 14. *N. truncata.*
Perithecia orange, fading to pale yellow, not truncate. 15. *N. conigena.*
Perithecia deep red, ranging in color from scarlet or blood-red to reddish-purple.
Perithecia with a few bristly hairs; plants on herbaceous stems. 16. *N. consors.*
Perithecia naked (with no well-developed hairs).
Perithecia conical or subconical in form.
Spores large, 15–17 × 5–6 mic. 17. *N. Papilionacearum.*
Spores small, 10–11 × 3–4 mic. 18. *N. Brassicae.*
Perithecia ovate; ostiolum very obtuse.
Spores narrow-fusoid; on wood. 19. *N. sanguinea.*
Spores broad-fusoid; on sphaeriaceous fungi. 20. *N. episphaeria.*

1. NECTRIA PEZIZA (Tode) Fries, Summa Veg. Scand. 288. 1849

Sphaeria Peziza Tode, Fungi Meckl. 2: 46. 1791.
? Peziza hydrophora Bull. Hist. Champ. 243. 1809.
Peziza (Dasyscypha) vulpina Cooke, Hedwigia 14: 82. 1875.
Dialonectria vulpina Cooke, Grevillea 12: 83. 1883.
Nectria rimincola Cooke, Grevillea 11: 108. 1883.
? Nectria lasioderma Ellis, Am. Nat. 17: 194. 1883.
Nectria Umbellulariae Plow. & Hark. Bull. Cal. Acad. Sci. 1: 26. 1884.
Nectria vulpina Ellis & Everh. N. Am. Pyrenom. 103. 1887.
Nectria betulina Rehm. Ann. Myc. 3: 519. 1905.

Perithecia superficial, scattered, gregarious or occasionally crowded, globose or subglobose, usually collapsing from the top becoming pezizoid, at first clothed with a scant covering of delicate, white mycelial threads (no true hairs) which disappear with age leaving the perithecia smooth or in very old specimens slightly rough and furfuraceous, 250–500 mic. in diameter (mostly 300), varying in color from deep-orange to pale-yellow, color darker in dried specimens but fading in weathered specimens; ostiolum minute in young specimens, just visible and in older forms depressed and inconspicuous; asci cylindrical or clavate, 8-spored, 50–75 × 5–6 mic.; spores broadly elliptical, obliquely 1-seriate or crowded, becoming partially 2-seriate, thick-walled, 1-septate, not constricted, with 1 large, conspicuous oil-drop in each cell, 10–14 × 4–6 mic. (mostly 10 × 5 mic.); paraphyses short, branched, not conspicuous (*pl. 4. f. 3; pl. 5. f. 1*).

On decaying, decorticated wood; more rarely on bark, fungi and old hemp cloth.

TYPE LOCALITY: Mecklenburg, Germany.

DISTRIBUTION: New York to Ontario, North Dakota and Louisiana.

ILLUSTRATIONS: Tode, Fungi Meckl. 2: *pl. 15. f. 122;* Bulliard, Herb. France, *pl. 410. f. 2;* Currey, Trans. Linn. Soc. 22. *pl. 57. f. 44;* Berkeley, Outl. Brit. Fung. *pl. 24. f. 6;* Grevillea, Crypt. Fl. 4. *pl. 186. f. 2.*

EXSICCATI: Ravenel, Fungi Am. Exsicc. *644;* Ellis, N. Am. Fungi *774;* Wilson & Seaver, Ascom. & Lower Fungi, *16.* Other specimens examined: California, *Harkness;* Iowa, *Arthur, Seaver;* Louisiana, *Langlois;* Maine, *Harvey;* New York, *Atkin-*

son, Brown, Seaver; North Dakota, *Seaver* (various collections); New Jersey, *Ellis* (various collections); Ohio, *Hawkins, Morgan;* Ontario, Canada, *Dearness, Macoun.*

Distinguished by the large, pale, globose-pezizoid perithecia and the broad-elliptical, non-constricted spores.

A more complete account of this species is being published in the Bulletin of the Torrey Botanical Club.

2. NECTRIA TREMELLOIDES Ellis & Everh. Jour. Myc. 2: 121. 1886

Perithecia gregarious, subglobose, coarsely furfuraceous, orange, fading to pale yellow, about 300 mic. in diameter, with a scant, dirty whitish mycelial growth near the base; asci clavate, 50 × 7 mic.; spores 1-seriate or partially 2-seriate above, hyaline, 1-septate, fusoid, very slightly constricted, 9–13 × 3–4 mic. (*pl. 5. f. 3*).

On bark of dead willow.

TYPE LOCALITY: Louisiana.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Louisiana, *Langlois 592* (type).

Distinguished by the large coarsely furfuraceous perithecia.

This species has been reported but once and the type specimen seems to be quite distinct in the presence of the bran-like granules with which the perithecia are covered but whether this character is constant must be decided from a study of fresh material.

3. NECTRIA DIPLOCARPA Ellis & Everh. Proc. Phil. Acad. Sci. 1890: 244. 1891

Perithecia gregarious or scattered, occasionally several closely crowded, superficial, subglobose, 250 mic. in diameter, nearly smooth, collapsing when dry and becoming pezizoid, flesh-colored; asci clavate, 40–50 × 8–12 mic.; spores elliptical, 8–12 × 4–5 mic., 1-septate, hyaline; in addition to the ordinary ascospores there are other large, hyaline, 1-septate, spore-like bodies 30–45 × 18–25 mic. present in the perithecia (*pl. 5. f. 2*).

On thallus of foliaceous lichens (*Parmelia?*).

TYPE LOCALITY: New York.

DISTRIBUTION: New York to Missouri.

SPECIMENS EXAMINED: New York, *Brown* (type).

As to the nature of the large bodies present in the perithecia, which are truly spore-like, it is difficult to determine. Mr. Ellis was of the opinion that they represent mature ascospores while the smaller spores present in the ascus are immature. This seems doubtful to us since the large bodies could not be found within an ascus.

The species very closely resembles *Nectria Peziza* (Tode) Fries, both in perithecial and spore characters, but is distinguished by its parasitic habitat as well as by the presence of the large spore-like bodies which accompany the asci within the perithecia.

4. **Nectria flavociliata** nom. nov.

Nectria bicolor Ellis & Everh. Proc. Acad. Nat. Sci. Phil. 1893: 443. 1893. Not *Nectria bicolor* Berk. & Br.

Perithecia thickly gregarious, large, 250–300 mic. in diameter, subglobose with a papilliform ostiolum, clothed, except a space around the ostiolum, with obtuse, septate, clavate hairs which are hyaline near the base but golden-sulphur-yellow near the apices; asci clavate, 35–40 × 7–8 mic., 8-spored; spores 2-seriate, crowded, fusoid, 1-septate, hyaline, 8–12 × 2.5–3 mic. (*pl.* 5. *f.* 11).

On dead twigs of *Carya.*

TYPE LOCALITY: Wilmington, Delaware.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Delaware, *Commons* (type).

Distinguished by the large, golden-yellow-ciliate perithecia.

"The yellow color of the hairy coat is the same as in *Nectria sulphurea* Ellis & Calk., but there is no subiculum, and in that species the perithecia are not hairy but simply pruinose. *Fusarium episphaericum* Cooke & Ellis* appears to be the conidial stage."

The hairs in this species are well developed and prominent. The name suggested by Ellis & Everh. is a homonym.†

5. NECTRIA LACTEA Ellis & Morgan; Ellis & Everh. N. Am. Pyrenom. 110. 1892

Perithecia minute, 125–200 mic. in diameter, nearly globose, gregarious or crowded, yellowish, at first clothed with a dense

* Grevillea 5: 50. 1876.

† Jour. Linn. Soc. 14: 116. 1875.

covering of delicate, white hairs so that the whole cluster of plants has a whitish appearance, except the ostiolum which is bare, becoming yellowish with age; hairs about 2 mic. in diameter, usually roughened externally with minute granules but occasionally smooth; asci cylindrical, 8-spored, 40–50 × 5 mic.; spores 1-seriate, broad-elliptical, hyaline, 1-septate, with 1 oil-drop in each cell, 5–8 × 3–4 mic. (*pl. 5. f. 5*).

On old fungi, *Polyporus, Stereum,* and also on rotten wood.

TYPE LOCALITY: Ohio.

DISTRIBUTION: New York to Ohio, Florida and Louisiana.

SPECIMENS EXAMINED: Florida, *Calkins;* New York, *Seaver;* Louisiana, *Langlois 1213;* Ohio, *Morgan* (type).

Distinguished by the broadly elliptical spores.

Two collections of fresh material of this species were made by the writer in the vicinity of New York City, during the autumn of 1906. The specimens collected were on old wood and correspond well with the type material of this species. In external appearance the species closely resembles *Nectria Rexiana* Ellis or *Nectria squamulosa* Ellis but spore characters are very different. The spores are similar in form and arrangement to those of *Nectria Peziza* (Tode) Fries but are much smaller.

6. NECTRIA REXIANA Ellis, Am. Nat. **17**: 194. 1883

Perithecia nearly globose, yellowish, clothed with a dense covering of long, flexuose, hyaline (white to the naked eye), septate, rough hairs, perithecia 150–200 mic. in diameter; asci cylindrical, 30–40 × 4–5 mic., 8-spored; spores mostly 1-seriate or partially 2-seriate above, minute, cylindrical or allantoid, hyaline, faintly 1-septate, 5 × 2 mic. (*pl. 5. f. 6*).

Parasitic on *Chondrioderma.*

TYPE LOCALITY: New York.

DISTRIBUTION: Maine to New York.

SPECIMENS EXAMINED: New York, *Rex* (type); Maine, *Harvey.*

Distinguished by the comparatively large perithecia and small size of the spores.

7. NECTRIA SQUAMULOSA Ellis, Bull. Torrey Club 9: 20. 1882

Perithecia gregarious, minute, 100–125 mic. in diameter, light colored (when dry nearly white) with a prominent ostiolum which

is darker, clothed externally, except the ostiolum, with a dense covering of delicate, hyaline hairs which are 2 mic. in diameter and 10–20 mic. long; asci narrowed above and below, 20–25 × 5–6 mic., 8-spored; spores mostly 2-seriate, minute, 6–7 × 1.5–2 mic., 1-septate, sometimes very slightly constricted (*pl. 5. f. 7*).

On rotten wood.

TYPE LOCALITY: New Jersey.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: New Jersey, *Ellis* (type).

Distinguished from the preceding by the smaller perithecia and slightly larger spores.

This and the preceding species very closely resemble each other both in external and internal characters, however there seems to be a slight difference so the two are here allowed to remain as distinct.

8. NECTRIA RUBEFACIENS Ellis & Everh. Jour. Myc. 3: 116. 1887

Perithecia scattered or gregarious, superficial, subglobose, 80 mic. in diameter, smooth or with a few poorly developed hair-like outgrowths, at first pale, becoming orange; asci broad-clavate, 35–40 × 12 mic., 8-spored; spores irregularly crowded, cylindrical-allantoid, hyaline or subhyaline, 1-septate, scarcely constricted at the septum, 14–18 × 2–3 mic (*pl. 5. f. 8*).

Parasitic on the thallus of some lichen, on dead limbs.

TYPE LOCALITY: Newfield, New Jersey.

DISTRIBUTION: New Jersey.

SPECIMENS EXAMINED: New Jersey, *Ellis* (type).

Distinguished by the allantoid spores.

In the original description of this species Mr. Ellis states: "The species has been observed now for the past eight years and seems to be quite distinct from any of the other lichenicolous species." He also stated that the thallus of the lichen *Parmelia tiliacea* (?) turns dull red (bright red within). The spores in the specimens examined by the writer are pale reddish but Mr. Ellis describes them in the fresh material as being hyaline.

9. NECTRIA THUJANA Rehm; Sacc. Michelia 1: 295. 1878

Perithecia scattered, or gregarious, pale orange, nearly globose, becoming depressed and more or less pezizoid; asci clavate,

60–80 × 13 mic., 8-spored; spores partially 2-seriate, broad-fusoid, 1-septate, very slightly constricted, 17–18 × 7 mic., hyaline (*pl. 5. f. 9*).

On dead foliage of *Cupressus*.

TYPE LOCALITY: Newfield, New Jersey.

DISTRIBUTION: Known only from type locality.

EXSICCATI: Ellis, North Am. Fungi, *130*. Other specimens examined: New Jersey, *Ellis* (cotype).

Distinguished by the size of the broad-fusoid spores as well as by the habitat.

Our own examination shows the spores to be larger than indicated by Mr. Ellis in previous descriptions. The perithecia except for the smaller size somewhat resemble those of *Nectria Peziza* (Tode) Fries but the species is readily distinguished by the difference in the form and size of the spores.

10. NECTRIA DISPERSA Cooke & Ellis, Grevillea 5: 33. 1876

? Nectria poliosa Ellis & Everh. Jour. Myc. 2: 39. 1886.

? Lasionectria poliosa Ellis & Everh. Jour. Myc. 3: 1. 1887.

Perithecia scattered, globose, with a minute ostiolum, orange, nearly smooth, collapsing; asci cylindrical, 70–80 × 10–12 mic. 8-spored; spores 1-seriate with the ends overlapping, subfusoid, a little constricted at the septum, often slightly unsymmetrical, with several oil-drops, hyaline, 18–22 × 7–10 mic.

On bark and old fungi.

Distinguished by the size of the spores.

TYPE LOCALITY: Maine.

DISTRIBUTION: Maine to (Florida ?).

ILLUSTRATIONS: Grevillea 5: *pl. 75. f. 14*.

SPECIMENS EXAMINED: Maine, *Blake* (cotype): Florida, *Calkins 138*.

A note is enclosed with the type of this species in the Ellis collection stating that the last mature perithecium had been used in writing the description for the Journal of Mycology so that the writer has little to draw from in the present work except the description by Mr. Ellis. Accepting the spore measurements given by Mr. Ellis this character is sufficient to distinguish the species from any of the others listed in this paper.

Nectria poliosa Ellis & Everh. corresponds with the above in

spore measurements, but from the description apparently differs in possessing perithecia which are clothed with hairs; the type here again is too meager to permit of a fair examination. This latter character is one which is very uncertain in the present genus, the perithecia of many of the species which are usually considered smooth being clothed when young with mycelial threads which often fall off later. This character seems to be very variable depending upon age and other conditions. In only a few cases in the present genus are the perithecia found to be clothed with well-developed hairs.

11. NECTRIA EUCALYPTI (Cooke & Hark.) Sacc. Syll. Fung. **9**: 969. 1891

Dialonectria Eucalypti Cooke & Hark.; Cooke, Grevillea **12**: 82. 1884.

Dialonectria depallens Cooke & Hark. Grevillea **12**: 82. 1884.

Nectria depallens (Cooke & Hark.) Sacc. Syll. Fung. **9**: 962. 1891.

Perithecia scattered, superficial, nearly globose, with a papilliform ostiolum, smooth, pale red to yellowish, entire or often collapsing, 200–250 mic. in diameter; asci clavate, 8-spored, 50–55 × 7–8 mic.; spores crowded, 18–22 × 4–5 mic., 1-septate, 2-seriate (*pl. 5. f. 10, 11*).

On *Eucalyptus* and stems of *Lupinus.*

TYPE LOCALITY: California.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: California, *Harkness* (probably cotype).

Distinguished by the pale perithecia and large fusoid spores.

Dr. Cooke in Grevillea (l. c.) distinguishes *Nectria depallens* (Cooke & Hark.) Sacc. from the above by a difference in the color of the perithecia the one being ochraceous and the other testaceous-red and by the larger size of the spores, those of *Nectria Eucalypti* being 16–18 × 4 mic. and *Nectria depallens* (Cooke & Hark.) Sacc. 22–24 × 4–4.5 mic. In the specimen examined by the writer of each of these species, both of which were collected in California by Harkness and are evidently cotype although not marked, the difference in the color of the perithecia is too slight and the character too variable to be considered. While

the difference in the size of the spores seems from the description to be quite marked, camera lucida drawings of the spores of the two specimens mentioned above which drawings accompany this paper show no marked difference either in form or size. I am unable to discover any character by which the two supposed species can be separated notwithstanding the fact that Saccardo (l. c.) has placed the two species in different subgenera.

12. NECTRIA APOCYNI Peck, Ann. Rep. N. Y. St. Mus. **26**: 84. 1874

Perithecia scattered or crowded in small clusters, subglobose, more or less collapsed when dry, slightly rough, dull red; ostiolum minute; asci clavate, 8-spored, 60–65 × 12 mic.; spores 2-seriate and often irregularly crowded, oblique, fusiform with ends acute, almost sharp, 1-septate, a little constricted at the septum, granular within, 18–22 × 5–6 mic. (*pl. 5. f. 12*).

On the lower part of the stems of Indian hemp, *Apocynum cannabinum.*

TYPE LOCALITY: North Greenbush, New York.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: New York, *Peck* (cotype).

The species is distinct in the large size and fusiform character of its spores.

The above description of the microscopic characters are taken from a part of the type collection which was received by the kindness of Mr. Peck. Other characters are recorded from his notes as the specimens are discolored with age and too small to draw conclusions as to the general appearance of the perithecia except that of the size. The species is easily distinguished from any of the other forms listed here by its fusiform spores which approach those of the genus *Hypomyces.*

Mr. Peck states (in letter) that he has seen this species but once. He has described the conidia as "subhemispherical or irregular, small, pale red; spores fusiform, straight, .0005–.0006 in. long." This description would seem to indicate the presence of a stroma although I have been unable to detect one. Until the species has been collected and studied from fresh material, it is difficult to decide this point.

13. NECTRIA SULPHUREA (Ellis & Calk.) Sacc. Syll. Fung. 9: 966. 1891

Dialonectria sulphurea Ellis & Calk.; Ellis & Everh. Jour. Myc. 4: 57. 1888.

Perithecia scattered, sulphur-yellow-pruinose and seated on a sulphur-yellow-pruinose base 1 or more cm. in diameter, often becoming reddish-brown with age, 200 mic. in diameter; asci evanescent; spores small, fusoid with the ends obtusely pointed, 1-septate and constricted at the septum, often with an oil-drop in each cell, 7–12 × 3–4 mic. (*pl. 5. f. 13*).

Parasitic on old fungi, *Stereum*.

TYPE LOCALITY: Jacksonville, Florida.

DISTRIBUTION: Ohio to Florida.

EXSICCATI: Ellis & Everhart, N. Am. Fungi, *1947*. Other specimens examined: Florida, *Calkins* (type); Ohio, *Morgan*.

Distinguished by the sulphur-yellow-pruinose perithecia and the sulphur-yellow-pruinose base, as well as by the habitat.

While the perithecia are seated on the yellow base this does not resemble a stroma but the substratum seems to be stained being of the same color as the perithecia themselves. In both specimens examined it has been impossible to make out an ascus but the arrangement of the spores seems to indicate its presence.

14. NECTRIA TRUNCATA Ellis, Am. Nat. 17: 194. 1883

Perithecia minute, 125–150 mic. in diameter, gregarious, yellowish (dried specimens almost white), slightly collapsing, becoming subtruncate, or with the ostiolum still more depressed so as to appear umbilicate; asci when young tapering into a rather pointed apex, finally clavate, 8-spored, 35–40 × 5 mic.; spores crowded, fusoid, 1-septate, slightly constricted, 12 × 2–3 mic. (*pl. 5. f. 14*).

On the inside of white cedar bark which has been stripped from the tree.

TYPE LOCALITY: Newfield, New Jersey.

DISTRIBUTION: Known only from type locality.

EXSICCATI: Ellis, N. Am. Fungi, *1332*. Other specimens examined: Newfield, New Jersey, *Ellis* (type).

Distinguished by the small, pale perithecia and minute spores.

15. NECTRIA CONIGENA Ellis & Everh. Bull Torrey Club **10**: 77. 1883

Dialonectria filicina Cooke & Hark. Grevillea **12**: 101. 1884.
Nectria filicina Sacc. Syll. Fung. **9**: 963. 1891.

Perithecia scattered or gregarious, often subcespitose, nearly globose with a minute ostiolum, smooth, orange, becoming pale yellow with age, entire or collapsing with age; asci clavate, 8-spored; spores partially 2-seriate or irregularly crowded, fusoid, 1-septate, slightly constricted, granular within, 8–10 × 3–4 mic. (*pl. 4. f. 8; pl. 5. f. 15, 16*).

On hard materials, stipe of tree fern, cone of *Magnolia,* shell of buckeye.

TYPE LOCALITY: Newfield, New Jersey.

DISTRIBUTION: New Jersey to Ohio and California.

SPECIMENS EXAMINED: New Jersey, *Ellis* (type); Ohio, *Morgan;* California *Harkness* (probably cotype of *Nectria filicina* Cooke & Hark.) Sacc.

Distinguished by the pale perithecia and small spores.

Aside from some comparatively slight variations in perithecia I can discover no character by which to distinguish *Nectria filicina* (Cooke & Hark.) Sacc. from *Nectria conigena* Ellis & Everh., although there seems to be a wide difference in the habitat of the two species. In the former the perithecia are mostly entire while in the latter they are partly collapsed. This difference however might be due to age since in both cases they show some tendency to collapse. The spores of the two forms are identical, as is shown from the accompanying drawing which was made with the aid of the camera lucida.

16. **Nectria consors** (Ellis & Everh.)

Dialonectria consors Ellis & Everh. Jour. Myc. **4**: 122. 1888.
Nectriella consors Sacc. Syll. Fung. **9**: 941. 1891.

Perithecia subconical, tapering above into an acute ostiolum, scarlet, minute, 125–150 mic. in diameter, clothed with bristle-like, obtusely pointed, septate, reddish hairs, except the ostiolum; asci clavate, 8-spored, 50 × 6–7 mic.; spores 2-seriate, fusoid, hyaline, 1-septate, 7–10 × 2–3 mic.

On dead stems of *Polygonum.*

TYPE LOCALITY: St. Martinsville, La.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Louisiana, *Langlois* (type).

Distinguished by the conical form of the perithecia and the bristle-like hairs.

The spores of this species were originally described as simple but our examination shows them distinctly 1-septate. Nothing is known of this species except from the type collection. In color the perithecia resemble those of *Nectria Brassicae* Ellis & Sacc. but differ from that species in the hairy perithecia. The species would seem to be very distinct in the presence of well-developed, bristle-like hairs which are colored slightly reddish. It is to be regretted that the type material of this species is so scant that it is impossible to make as careful study of the species as would otherwise.

17. **Nectria Papilionacearum** sp. nov.

Plants hypophyllous, scattered or gregarious, accompanying other sphaeriaceous fungi (*Pardiella*), surrounded at the base by a few white mycelial threads; perithecia subconical, bright red, nearly scarlet, 150–175 × 175–200 mic., walls coarsely cellular; cells very variable but averaging 8–10 mic. in diameter; asci clavate, 8-spored, 75 × 10 mic.; spores 2-seriate above, often 1-seriate below, fusoid, 1-septate, constricted at the septum, with 1 or more oil-drops in each cell, 15–17 × 5–6 mic. (*pl. 4. f. 7; pl. 5. f. 19*).

On leaves of papilionaceous plants, *Lespedeza* and *Rhynchosia*, accompanying other sphaeriaceous fungi (*Parodiella*).

TYPE LOCALITY: Missouri.

DISTRIBUTION: Missouri to S. Carolina.

EXSICCATI: Ravenel, Fungi Am. Ex. *647*. Other specimens examined: Missouri, *Kellermann, 1002, 1003*.

The specimens in Ravenel's exsiccati were distributed as *Nectria Peziza* Fries from which they are very different both in gross and microscopic characters.

The specimens collected by W. A. Kellermann in Missouri, from which this description is drawn, were first referred to *Nectria erubescens* Desm., from which they also differ in both external and spore characters. They were later referred to *Nectria episphaeria* (Tode) Fries, which they quite closely

resemble. The form of the perithecia, size of the spores and phyllogenous habitat are sufficient to set it apart as distinct from that species.

As to whether these plants occur on the living leaves no statement is made by the collectors, but the leaves appear to have been collected in the living condition and since the fungi which they accompany are reported to be parasitic it is likely that the *Nectria* also occurs on the leaves while living. Although accompanying *Parodiella* the plants do not seem to be parasitic on the fungus, but since in the three specimens examined the *Nectria* accompanies the *Parodiella* there may be a close relationship between the two fungi as well as between the fungi and the leguminose host on which they occur.

18. NECTRIA BRASSICAE Ellis & Sacc.
Michelia **2**: 374. 1881

Perithecia scattered or gregarious, subconical, entire or bilaterally-collapsing, blood-red, 120–150 mic. in diameter; perithecial wall composed of coarse cells, variable in form and size, 5–8 mic. in diameter; asci clavate, 60 × 7–8 mic., 8-spored; spores mostly 2-seriate, fusoid or subclavate, 1-septate, hyaline, 10–11 × 3–4 mic. (*pl. 5. f. 20*).

On herbaceous stems of various kinds, *Brassica, Solanum, Ipomoea,* etc.

TYPE LOCALITY: New Jersey.

DISTRIBUTION: New Jersey to Louisiana.

EXSICCATI: Ellis, N. Am. Fungi *572, 572b;* Ellis & Everhart's Fungi Columb. *1747*. Other specimens examined: New Jersey, *Ellis* (cotype); Louisiana, *Langlois 1208, 1775, 1804.*

Closely related to *Nectria sanguinea* (Bolton) Fries, but distinguished by a difference in the form and size of the perithecia as well as by a slight difference in the size and arrangement of the spores. The perithecia resemble in form, *Nectria Papilionacearum* Seaver, but the spores are very different.

19. NECTRIA SANGUINEA Fries, Summa Veg.
Scand. 388. 1845

Sphaeria sanguinea Bolton, Fungi Halifax 3: 121. 1789.
?Hypoxylon phoeniceum Bull. Herb. France, *pl. 487. f. 3.* 1790.

Nectria athroa Ellis & Everh. Proc. Acad. Nat. Sci. Phil., 1890: 247. 1891.

Nectria viticola Berk. & Curt. Grevillea 4: 45. 1875.

Perithecia gregarious or scattered, superficial, ovoid, mostly entire, but often collapsing when prematurely dried, smooth, blood-red, shining, about 200–275 × 250–300 mic. when mature; ostiolum obtuse but very prominent; asci cylindrical, 60–75 × 6–7 mic., 8-spored; spores obliquely arranged in the ascus, 1-seriate below, partially 2-seriate, above, narrow fusoid or subelliptical, slightly constricted, 10–12 × 4–5 mic., granular within (*pl. 4. f. 6; pl. 5. f. 17*).

TYPE LOCALITY: Nova Scotia.

DISTRIBUTION: Nova Scotia to New Jersey, Ohio and Kansas.

ILLUSTRATIONS: Bolton, Fungi Halifax, 3: *pl. 121. f. 1;* Bulliard, Herb. France *pl. 487. f. 3.*

SPECIMENS EXAMINED: Alabama, *Peters 5225* (cotype of *N. viticola* Berk. & Curt.); New Jersey, *Ellis;* New York, *Seaver;* Ohio, *Morgan;* Kansas, *Kellerman & Swingle 1325.*

Distinguished by the blood-red, ovoid, mostly entire perithecia and their habitat on rotten wood.

This species is usually attributed to Sibthorp,* although Bolton's description quoted above antedates that of Sibthorp by five years. No type specimen of this species has been seen and it is doubtful if such exists but the species is so well defined that Bolton's description and accompanying illustrations leave little chance for doubt as to its identity. The species is fairly well marked by the ovoid, blood-red perithecia which occur on rotten wood entirely destitute of stroma. The following is the note accompanying the original description.

"This *Sphaeria* grows on putrid wood; great numbers grow in close neighborhood but do not in any wise adhere to one another. They are oval or egg-shaped; the base broader than the top. Each has a perforation in the top, and is about the size of a poppy seed, as in the lower figure; the other figures shew them as they appear when magnified and cut both perpendicularly and horizontally. The colour on the outside is deep, bright bloody hue; the surface shining with a gloss like polished coral; the inside and seeds are white."

* Sibth. Fl. Oxoniensis 404. 1794.

The perithecia and spores of *Nectria athroa* Ellis & Everh. are a little smaller than the average of this species but this may be due to immature specimens. In other respects this is a typical specimen of the above species.

20. NECTRIA EPISPHAERIA (Tode) Fries, Summa Veg. Scand. 388. 1845

Sphaeria episphaeria Tode, Fungi Meckl. **2**: 21. 1791.

Perithecia gregarious or scattered, superficial, subovoid, for the most part bilaterally collapsing when dry, smooth, blood-red, perithecial wall composed of rather coarse cells, perithecia variable but ranging from 150–250 mic. in diameter; asci cylindrical, 60 × 5 mic., 8-spored; spores obliquely 1-seriate, broad-fusoid, 4–6 × 9–12 mic. (mostly 5 × 10), 1-septate, hyaline (*pl. 4. f. 1, 2; pl. 5. f. 18*).

On old fungi of various kinds, especially sphaeriaceous fungi.

TYPE LOCALITY: Mecklenburg, Germany.

DISTRIBUTION: New York to California and Canada to Nicaragua.

ILLUSTRATION: Tode, Fungi Meckl. **2**: *pl. 11. f. 89.*

EXSICCATI: Ellis, N. Am. Fungi *469, 469* (*b*); Ravenel, Fungi Am. Exsicc. *340;* Smith, Central Am. Fungi *4.* Other specimens examined: Alabama, *Carver 305, Earle;* California, *Harkness;* Connecticut, *Thaxter;* Kansas, *Kellerman & Swingle;* Louisiana, *Langlois;* Maine, *White;* New Hampshire, *Farlow;* New Jersey, *Ellis, Brown, Small;* New York, *Peck;* North Dakota, *Seaver* (various collections); Nicaragua, C. Am., *Smith;* S. Carolina *Ravenel 551.*

Distinguished by the broad-fusoid spores as well as by the habitat and manner of collapsing.

This species very closely resembles the preceding and is considered by most writers as scarcely distinct. The habitat and manner of collapsing are usually given as the distinguishing characters. From our own studies the species would seem to differ in the spore characters as well. In the present species the spores are broad-fusoid and approximately twice as long as broad, while in the preceding, *Nectria sanguinea* (Bolton) Fries, they are narrow-fusoid or approximately three times as long as broad. This difference is shown in the camera lucida drawing of the two

species which accompanies this paper, which drawings are made from material which is typical of the two species. A careful study of material from widely different localities is necessary in order to determine whether or not this character is constant.

DOUBTFUL SPECIES

Dialonectria gibberelloides Ellis & Everh. Jour. Myc. 4: 122. 1888. *Nectria gibberelloides* (Ellis & Everh.) Sacc. Syll. Fung. 9: 963. 1891.

Perithecia scattered, nearly black (quite black in dried material), 150–200 mic. in diameter, contracted into a stem-like base below, finally collapsing; asci clavate, 8-spored, 35 × 5–6 mic.; spores partially 2-seriate, fusoid, 1-septate, straight or slightly curved, hyaline, 12–15 × 2.5–3 mic.

On dead stalks of *Zea Mays*.

TYPE LOCALITY: Louisiana.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Louisiana, *Langlois 1457* (type).

As would be inferred by the specific name, this species resembles a *Gibberella* but differs in the absence of blue color from the perithecia, the 1-septate spores and a difference in the form of the perithecia. The spores resemble those of the genus *Nectria* but it is doubtful from the general appearance of the plants if they should be included with this genus. If color be regarded strictly as a characteristic of the order Hypocreales this species could scarcely be included with the order.

Nectria (*Lasionectria*) *setosa* Ferd. & Winge, Bot. Tidsskrift 29: 11. 1908.

Perithecia superficial, scattered or slightly gregarious, at first globose, then plane when dry pezizoid-collapsing, 250–500 mic. in diameter, flesh-colored or orange, hairs scattered, of the same color, rigid, thickened below, above slightly attenuate and finely divided (conidiophorous) as long as 100 mic., principally near the base; asci when young, lanceolate-subfusoid, when mature cylindrical-clavate, 50–70 mic. (p. sporif.) × 8–10.5 mic., narrowed into stem as long as 20 mic.; 8-spored; spores above 2 seriate, below 1-seriate oblong-elliptical, ends rotundate, not at all or scarcely constricted at the septum, 12–14.5 × 5–6 mic., hyaline.

On decayed dried sheaths of *Musa* sp.

TYPE LOCALITY: St. Thomas, W. Indies.

DISTRIBUTION: St. Thomas to St. John.

ILLUSTRATIONS: Bot. Tidsskrift **29**: *pl. 1. f. 4.*

No type specimen of this species has been seen, but a specimen collected on decaying leaves of *Musa* in Jamaica by Dr. W. A. Murrill corresponds well with the above description. The specimens examined differ from *Nectria Peziza* (Tode) Fries, which they quite closely resemble in general appearance, in the nature of the fairly well developed hairs which clothe the perithecia, and also in the spores, which are longer and proportionately narrower than in that species. Also, the perithecia are of a deeper red color.

6. CALONECTRIA de Not. Comm. Critt. Ital. **2**: 477. 1867

Perithecia free, often closely gregarious, or scattered, with no true stroma but perithecia often surrounded with radiating white mycelia which give to some of the species a stromate appearance; perithecia globose to ovate, red or yellow; asci elongated, 8-spored; spores elongated, more than 1-septate.

Type species: *Calonectria Daldiniana* de Not.

Distinguished from *Nectria* by the many-septate spores. The genus as treated here is used in its restricted sense including only the non-stromatic species. The three species described here occur on the remains of other fungi so that the substratum with the white mycelium which surrounds each perithecium gives the stromatic appearance but close examination will show the perithecia to be entirely free, not connected by a stroma or stromatic base.

Spores small, not exceeding 15 mic. in length.	1. *C. erubescens.*
Spores large, 25–35 mic. in length.	
Spores subelliptical; plants occurring on fungi on dead branches.	2. *C. diminuta.*
Spores fusiform; plants on leaves.	3. *C. melioliodes.*

1. CALONECTRIA ERUBESCENS (Rob.) Sacc. Michelia **1**: 309. 1878.

Sphaeria erubescens Rob.; Desm. Ann. Sci. Nat. III. **6**: 72. 1846.

Perithecia minute, gregarious in clusters or scattered, surrounded by a scant growth of radiating mycelial threads, at first pale red, fading to pale yellow, subglobose, with a minute ostiolum, often collapsing when dry, becoming pezizoid; asci clavate,

35–40 × 6 mic., 8-spored; spores crowded, small, elliptical to fusoid, 1–3-septate, 10–12 × 2–3 mic.

On living leaves of various kinds, usually on the remains of *Meliola.*

TYPE LOCALITY: France.

DISTRIBUTION: Florida.

EXSICCATI: Desm. Pl. Crypt. de France *1766* (cotype). Other specimens examined: Florida, *Nash 1955, Calkins 66,* and *Martin.*

In the original description of this species no mention is made of its occurrence on *Meliola* but aside from this fact the American material examined conforms well with that from Europe.

2. CALONECTRIA DIMINUTA (Berk.) Berl. & Vogl.; Sacc. Syll. Fung. 9: 985. 1891

Nectria diploa diminuta Berk. Grevillea 4: 46. 1875.

Dialonectria diminuta Cooke, Grevillea 12: 83. 1884.

? Calonectria Dearnessii Ellis & Everh. Proc. Acad. Nat. Sci. Phil. 1890: 245. 1891.

Perithecia minute, 150–175 mic. in diameter, scattered or more or less crowded on the substratum surrounded by radiating mycelium giving somewhat the appearance of a stroma while no true stroma is present, orange, partially collapsing; asci cylindrical or clavate, 8-spored; spores irregularly crowded, variable in size and form, elliptical, clavate or subfusoid, usually 3-septate, hyaline, 25–35 × 6–7 mic.

On sphaeriaceous fungi, *Massaria,* etc.

DISTRIBUTION: S. Carolina to Canada (?).

EXSICCATI: Ellis & Everh. N. Am. Fungi *2548.* Other specimens examined: London, Ontario, *Dearness 1346* (type of *C. Dearnessii* Ellis & Everh.).

3. CALONECTRIA MELIOLOIDES Speg. Anal. Soc. Ci. Argent. 19: 41. 1886

Calonectria guarapiensis Speg. Anal. Soc. Ci. Argent. 19: 41. 1886.

Plants gregarious and surrounded by an evanescent, white mycelial growth consisting of delicate radiating hyphae; perithecia subglobose to ovate, 200–250 mic. in diameter with the wall composed of irregular cells 5–8 mm. in diameter, clothed with a

few rigid, hyaline, many-septate hairs with a bulbose base; hairs 7–8 mic. in diameter and 200–400 mic. long; asci clavate, 8-spored, 80–100 × 12–15 mic.; spores 2-seriate or irregularly crowded, fusiform, 3-septate, hyaline, 30–35 × 7–8 mic.

On the mycelium of *Meliola* on living leaves.

TYPE LOCALITY: Brazil.

DISTRIBUTION: Louisiana.

EXSICCATI: Roumeguere, Fungi Sel. Exsicc. *4141* (cotype); Roumebuere, Fungi Gall. Exsicc. *4047* (cotype of *C. guarapiensis* Speg.); Louisiana, *Langlois 2224*.

This species resembles in external appearance as well as in habitat the various specimens of *Calonectria erubescens* (Rob.) Sacc., but are easily distinguished by the difference in form and much larger spores. Also in some of the specimens examined the two species seem to occur together, some of the perithecia containing the large spores and others the small spores which are characteristic of the two species respectively.

DOUBTFUL SPECIES

Calonectria Curtisii (Berk.) Sacc. Michelia 1: 316. 1878.

7. OPHIONECTRIA Sacc. Michelia 1: 323. 1878

Perithecia scattered or gregarious, globose or pyriform, superficial, light-colored, yellow or brownish; asci cylindrical to clavate, 8-spored; spores very much elongated, approaching filiform, at least 10 times as long as broad, many-septate.

Type species: *Nectria trichospora* Berk. & Br.

The genus is distinguished from *Calonectria* by the spores, which are much longer, approaching or entirely filiform. Only the non-stromatic forms are treated here.

Perithecia globose or subglobose, spores 35–50 mic. long, on fungi.	1. *O. cerea.*
Perithecia elongated, substipitate, spores 60–75 mic.	2. *O. cylindrothecia.*

1. OPHIONECTRIA CEREA (Berk. & Curt.) Ellis & Everh. N. Am. Pyrenom. 118. 1892

Sphaeria cerea Berk & Curt. Grevillea 4: 108. 1876.

Calonectria cerea Sacc. Syll. Fung. 2: 551. 1883.

Nectria (*Calonectria*) *fulvida* Ellis & Everh. Jour. Myc. 1: 140. 1885.

Dialonectria fulvida Ellis & Everh. Jour. Myc. 2: 136. 1886.

Ophionectria Everhartii Ellis & Galw. Jour. Myc. 6: 32. 1890.

Perithecia gregarious, nearly globose, dull yellow becoming darker with age, more or less rough and furfuraceous externally, or with a few hair-like outgrowths, with a papilliform ostiolum, 150–175 mic. in diameter; asci cylindrical, 8-spored, 65–80 × 8–12 mic.; spores varying from fusiform to cylindrical or clavate, straight or curved, with the ends usually acute, hyaline or very pale yellow, 7–10-septate, 35–50 × 3–3.5 mic.; paraphyses short, indistinct.

On old fungi, especially *Diatrype*.

TYPE LOCALITY: S. Carolina.

DISTRIBUTION: Newfoundland and Ontario to S. Carolina.

ILLUSTRATION: Ellis & Everh. N. Am. Pyrenom. *pl. 15. f. 1–3.*

SPECIMENS EXAMINED: Newfoundland, *Waghorne 755;* Ontario, *Dearness 2292;* New Jersey, *Ellis* (type of *D. fulvida* and *O. Everhartii*).

Distinguished by the globose, slightly furfuraceous perithecia and by the habitat.

2. **Ophionectria cylindrothecia** sp. nov.

Perithecia gregarious or scattered, cylindrical to clavate or fusoid, tapering below into a stem-like base, also tapering above, yellowish, translucent, nearly smooth, rather hard when dry, often with a few septate, hair-like mycelial strands near the base, naked above, 125–150 × 275–300 mic.; asci cylindrical or clavate, 8-spored, 100–125 × 12–15 mic.; spores apparently enclosed in a separate membrane within the ascus, so that the outer wall of the ascus stretches 10–20 mic. beyond the apex of the spore cluster; individual spores tapering toward either end, hyaline or very slightly yellowish, 7–12-septate, 60–75 × 5 mic.; paraphyses present, indistinct (*pl. 4. f. 4*).

On old corn stalks, *Zea Mays.*

TYPE LOCALITY: Ohio.

DISTRIBUTION: Known only from type locality.

Ohio, *Morgan 1007* (type).

Distinguished by the elongated perithecia and the large size of the asci and spores as well as by the habitat.

This specimen in the Ellis collection and also in the material received from Mr. Morgan, which is a part of the type collection, is labeled *Ophionectria cerea* (Berk. & Curtis) Ellis & Everh., but examination of this material shows it to be entirely different from other specimens of *Ophionectria cerea* (Berk. & Curtis) Ellis & Everh. in external as well as in microscopic details. Its habitat is also entirely different from that species.

9. NEOCOSMOSPORA Smith, U. S. Dept. Agric. Div. Veg. Phys. Path. Bull. **17**: 7–59. *pl. 1–10.* 1899

Perithecia as in *Nectria* (bright red in the known species); asci numerous; ascospores in one row, brown, globose or short-elliptical, continuous, with a distinct, wrinkled exospore (the latter sometimes wanting in smaller spores); paraphyses present, inconspicuous, broad, loosely jointed, unbranched, consisting of about 5 cells.

Three conidial stages, *Cephalosporium, Fusarium* and *Oidium.*

1. Microconidia (*Cephalosporium* stage). Spores colorless, oval to narrow-elliptical, straight or slightly curved, simple, 4–25 × 2–6 mic., borne singly on the ends of short branches of a mycelium which fills the water ducts and interior parts of the living stems of melon and cowpea, conidia often 1–2-septate in cultures.

2. Macroconidia (*Fusarium* stage). Spores lunulate, 3–5-septate, 30–40 × 4–6 mic., borne on the surface of dead stems in immense numbers on innumerable, small, oval or hemispherical conidial beds; conidiophores compact, irregularly branched, single spores colorless, in mass pink to deep salmon-color.

3. On the surface of the dead stems of watermelon and in old cultures of the melon fungus on horse dung, globose, thin-walled, smooth, terminal or intercalary bodies are formed, in mass brick-red, individuals 10–12 mic. in diameter, extreme limits, 7–15 mic.

Type species: *Fusarium vasinfectum* Atk.

The position of this genus is uncertain.

1. NEOCOSMOSPORA VASINFECTA (Atk.) Smith, U. S. Dept. Agric. Div. Veg. Phys. Path. Bull. **17**: 7–50. *pl. 1–10.* 1899

Fusarium vasinfectum Atk. Ala. Agric. Exp. Sta. Bull. **41**: 28. 1892.

Perithecia gregarious, often closely crowded, bright red, smooth, with a very prominent, obtuse ostiolum, becoming per-

forate; perithecial wall composed of large cells, 12–15 mic. in diameter; perithecia 200–225 × 250–275 mic.; asci nearly cylindrical, 8-spored, 85–90 × 12–15 mic.; spores 1-seriate or often irregularly crowded, globose or subglobose, at first hyaline and surrounded with a transparent exospore, becoming brown, with several large oil-drops within, at maturity outer surface becoming wrinkled and rough, mostly 10 × 10 mic. in diameter; paraphyses present, inconspicuous, simple, septate.

Parasitic on cotton and okra, *Gossypium herbaceum*, *G. Barbadense* and *Hibiscus esculentus*.

TYPE LOCALITY: Alabama.

DISTRIBUTION: S. Carolina to Virginia and Arkansas.

EXSICCATI: Ellis & Everhart's Fungi Columbiana *1434*. Other specimens examined: Alabama, *Earle* (for perithecial characters).

Neocosmospora vasinfecta tracheiphila Smith, l. c.

Nectriella tracheiphila Smith, Proc. A. A. A. Sci. **44**: 190. 1895 (hyponym).

Perithecia as above, spores mostly 12 × 12 mic. Parasitic on cowpea, *Vigna sinensis*.

Neocosmospora vasinfecta nivea Smith, l. c.

Fusarium niveum Smith, Proc. Am. Ass. Adv. Sci. **43**: 289. 1894 (hyponym).

Perithecia as above; spores globose or elliptical, wrinkled or smooth generally smaller than in the preceding and more often elliptical. Parasitic on watermelon.

10. MELANOSPORA Corda, Ic. Fung. 1: 24. 1837.

Perithecia superficial, without stroma, globose-pyriform, with a long neck, usually clothed at the tip with a fringe of hairs and perithecia often hairy; asci broad-clavate, 4–8-spored; spores simple, colored, brown or brownish-black.

Type species: *Melanospora Zamiae* Corda.

The genus *Melanospora* is distinguished from *Ceratostoma* mainly by the lighter color and less decidedly carbonaceous perithecia. The two genera grade so closely into each other that it becomes difficult to draw a fast line between them although some of the species show undoubted relationship with the Hypocreales.

Of the three species recorded for North America one undoubtedly belongs to this genus while the other two are here included doubtfully.

1. MELANOSPORA CHIONEA (Fries) Corda, Ic. Fung. 1: 24. 1837

Ceratostoma chioneum Fries, Obs. Myc. 2: 340. 1818.

Sphaeria chionea Fries, Syst. Myc. 2: 446. 1822.

Perithecia gregarious or scattered, globose, clothed with a dense covering of white hairs, with a light colored beak up to 1 mm. long and 100 mic. in diameter, clothed with a few hairs at the apex; hairs which clothe the perithecia, 3 mic. in diameter, septate, long and flexuose; asci evanescent, obovate-clavate, stipitate, 8-spored, 35–40 × 13–16 mic.; spores 2-seriate or irregularly crowded, globose-elliptical, brown, 10–12 × 9–10 mic. (*pl. 4. f. 9*).

On decaying pine leaves and more rarely on leaves of deciduous trees.

TYPE LOCALITY: Europe.

DISTRIBUTION: Ontario.

ILLUSTRATIONS: Fries, Obs. Myc. 2: *pl. 7. f. 2;* Corda, Ic. Fung. 1: *pl. 7. f. 297 B;* Ellis & Everh. N. Am. Pyrenom. *pl. 14. f. 1–5.* Winter, Rabenh. Krypt. Fl. 1^2: 85. *f. 1–3.*

SPECIMENS EXAMINED: Ontario, *Dearness 1370.*

The American material of this species corresponds very closely with European specimens examined except in the matter of habitat. A specimen of the species from the herbarium of Fries is contained in the collection of the New York Botanical Garden but unfortunately it shows no perithecia, these having doubtless been removed by those who have previously studied the specimen. Other European specimens have been studied with which our material is identical.

DOUBTFUL SPECIES

Melanospora parasitica Tul. & Tul. Sel. Fung. Carp. 3: 10. 1865. *Sphaeronema parasitica* Tul. Ann. Sci. Nat. IV. 8: 40. (Note 2). *Ceratostoma biparasiticum* Ellis & Everh. Bull. Torrey Club 24: 127. 1897.

Perithecia scattered, enveloped in a growth of white, septate, mycelial threads about 3 mic. thick, black, at least when mature, ovate, 100–175 mic. in diameter, with a long, slender, naked beak, about 1 mm. in length and 30–40 mic. in diameter; asci clavate, 8-spored, 20 × 6 mic.; spores elongated, cylindrical, with the ends rounded, pale brownish, 6–7 × 2 mic.

Parasitic on stems of *Isaria farinosa.*

TYPE LOCALITY: Europe.

DISTRIBUTION: Ohio to New York.

ILLUSTRATIONS: Tul. & Tul. Sel. Fung. Carp. 3: *pl. 3. f. 11–14;* Grevillea 11: *pl. 158. f. 3.*

SPECIMENS EXAMINED: Ohio, *Lloyd;* New York, *Wilson, Seaver.*

Sphaeria lagenaria Pers. Syn. Fung. 58. 1801. *Ceratostoma lagenarium* Fries, Summa Veg. Scand. 396. 1849. *Auerswaldia lagenaria* Rabenh. Hedwigia 1: 116. 1856. *Melanospora lagenaria* (Pers.) Fuckel, Symb. Myc. 1: 126. 1869.

Perithecia scattered or gregarious, nearly globose, sparingly clothed with pale brown hairs, 400–500 mic. in diameter, with a beak, 1–2 mm. long and 100 mic. in diameter, tip of beak clothed with hyaline hairs, entire perithecium at maturity black; asci broad-clavate, 35–40 × 12–15 mic.; spores elliptical or fusoid, at first hyaline, becoming dark brown, 12–16 × 10–11 mic.

On old fungi (*Polyporus*).

TYPE LOCALITY: Europe.

DISTRIBUTION: New York.

SPECIMENS EXAMINED: New York, *Clinton.*

In this and the preceding species the perithecia are entirely black (at least in mature specimens). From general appearance it would seem doubtful to the writer if they should be included with this genus.

11. LETENDRAEA Sacc. Michelia 2: 73. 1880.

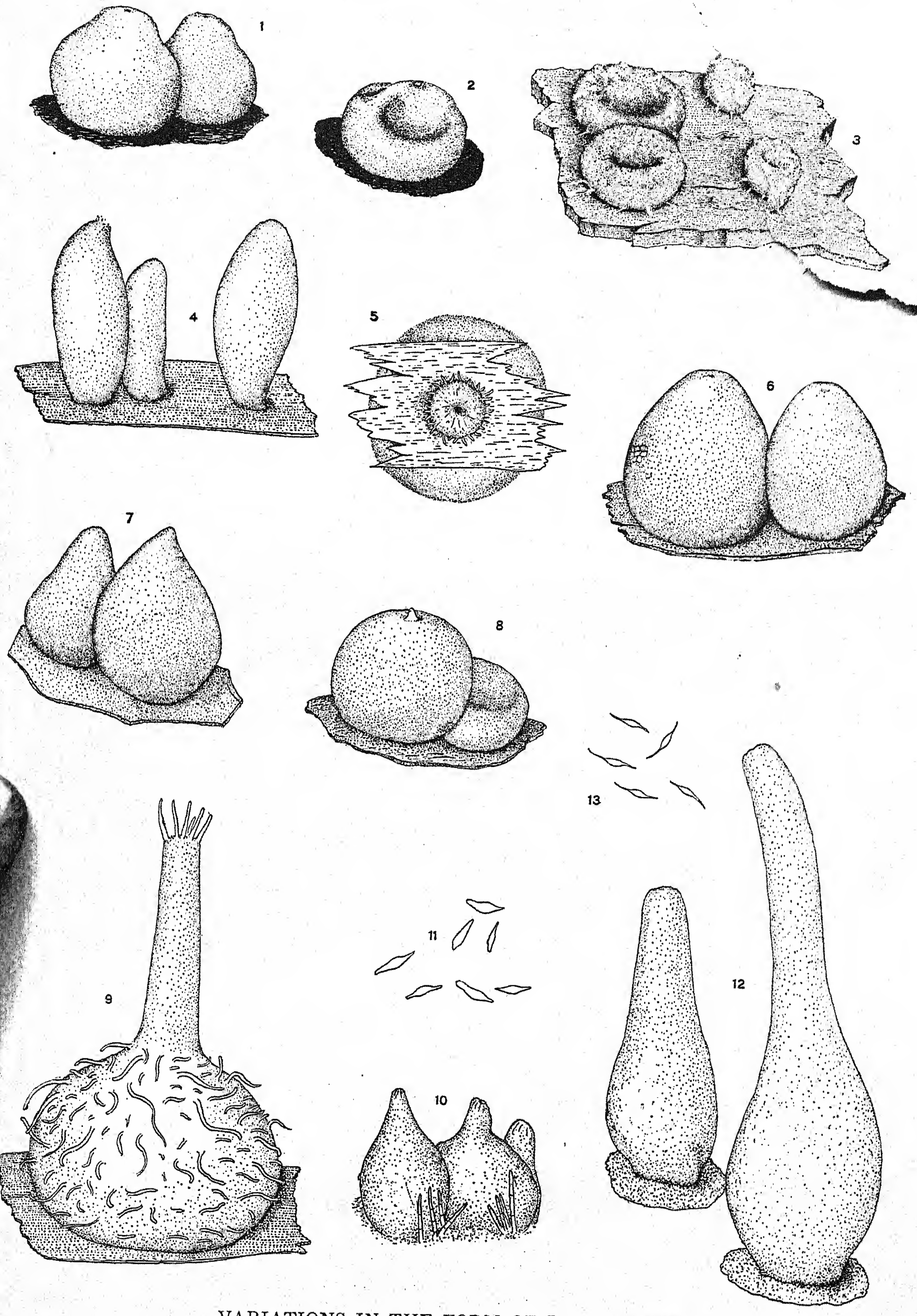
Perithecia superficial, gregarious, globose or ovate, with a papilliform ostiolum; asci 8-spored, cylindrical or clavate; spores elliptical or fusoid, 1-septate, brown.

Type species: *Letendraea eurotioides* Sacc.

Distinguished from subgenus *Phaeonectria* Sacc. by the absence of stroma.

1. LETENDRAEA LUTEOLA Ellis & Everh. Proc. Phil. Acad. Sci. 1895: 415. 1895

Perithecia gregarious, 250–300 mic. in diameter, brown, becoming black with extreme age, with a prominent ostiolum, entire or occasionally collapsing; asci cylindrical, 75 × 5 mic.; spores mostly 1-seriate or partially 2-seriate above, elliptical, straight



VARIATIONS IN THE FORM OF PERITHECIA

or slightly curved, becoming brown, 1-septate, scarcely constricted at the septum, with an oil-drop in each cell, 10–12 × 4–5 mic.; paraphyses present, delicate.

On rotten wood.

TYPE LOCALITY: Ohio.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Ohio, *Morgan 1109* (type).

In the specimens examined the perithecia are gregarious but with no apparent stroma. The large brown perithecia and the brown septate spores are sufficient characters by which the species may be recognized.

EXPLANATION OF PLATE IV.

1. *Nectria episphaeria* (Tode) Fries. The perithecia as they appear when moist, × 85.
2. *Nectria episphaeria* (Tode) Fries. One of the bilaterally collapsing perithecia as they appear when dry, × 85.
3. *Nectria Peziza* (Tode) Fries. Perithecia subglobose, pezizoid-collapsing, × 30.
4. *Ophionectria cylindrothecia* Seaver. Perithecia subcylindrical, × 85.
5. *Hyponectria dakotensis* Seaver. Perithecia subepidermal, × 100.
6. *Nectria sanguinea* (Bolton) Fries. Perithecia ovate, entire, × 85.
7. *Nectria Papilionacearum* Seaver. Perithecia subconical, × 85.
8. *Nectria conigena* Ellis & Everh. Perithecia entire or pezizoid-colapsing, × 85.
9. *Melanospora chionea* (Fries) Corda. Perithecia flask-shaped, hairy, × 85.
10. *Eleuthromyces Geoglossi* (Ellis & Everh.) Seaver. Perithecia subflask-shaped, × 85.
11. *Eleuthromyces Geoglossi* (Ellis & Everh.) Seaver. Subappendiculate spores, × 1,000.
12. *Eleuthromyces subulatus* Fuckel. Perithecia subflask-shaped, × 85.
13. *Eleuthromyces subulatus* Fuckel. Appendiculate spores, × 1,000.

EXPLANATION OF PLATE V.

The spores on this plate were drawn with the camera lucida, the object being to show the comparative size and form of the spores in the different species of the genus *Nectria*. The drawings are from type material where such is available. In a few cases the type specimens were too scant to permit of such drawings.

1. *Nectria Peziza* (Tode) Fries. Drawn from material collected by the writer.
2. *Nectria diplocarpa* Ellis & Everh. Drawn from type material.
3. *Nectria tremelloides* Ellis & Everh. Drawn from type material.
4. *Nectria flavociliata* Seaver. Drawn from type material.
   Nectria bicolor Ellis & Everhart. Drawn from type material.
5. *Nectria lactea* Ellis & Morgan. Drawn from type material.
6. *Nectria Rexiana* Ellis. Drawn from type material.
7. *Nectria squamulosa* Ellis. Drawn from type material.
8. *Nectria rubefaciens* Ellis & Everh. Drawn from type material.
9. *Nectria thujana* Rehm. Drawn from Ellis, N. Am. Fungi 160. This material was collected in the type locality and identified by Mr. Ellis, who collected the type material. Cotype material has been examined, but the perithecia are so scarce that it was impossible to find any in good condition.
10. *Nectria Eucalypti* Cooke & Harkness. Drawn from material collected by Harkness in the type locality. Probably cotype.
11. *Nectria depallens* Cooke & Harkness. Drawn from material collected by Harkness. Probably cotype.
12. *Nectria Apocyni* Peck. Drawn from cotype material.
13. *Nectria sulphurea* Ellis & Calkins. Drawn from type material.
14. *Nectria truncata* Ellis. Drawn from type material, in which it was difficult to find mature spores.
15. *Nectria conigena* Ellis & Everh. Drawn from type material.
16. *Nectria filicina* Cooke & Harkness. Drawn from material collected by Harkness. Probably cotype.
17. *Nectria sanguinea* (Bolton) Fries. Drawn from Rehm's Ascomyceten 1771.
18. *Nectria episphaeria* (Tode) Fries. Drawn from material collected in Ohio on *Diatrype* sp.
19. *Nectria Papilionacearum* Seaver. Drawn from type material.
20. *Nectria Brassicae* Ellis & Sacc. Drawn from N. Am. Fungi 572. Probably cotype.

SPORES OF SPECIES OF NECTRIA

FILLING TREE CAVITIES

J. J. Levison

(With Plate 6, Containing Four Figures)

Everyone recognizes the necessity of filling a decayed cavity in a tooth. Everyone knows that the decayed material in the cavity must be removed in order to prevent the destruction of the whole tooth and that the opening must then be filled in order to keep out the further accumulation of injurious substances. Still, there are some who might be surprised to hear of scientific tree "dentistry," or tree filling, although the underlying principles and necessity for such treatment are alike in both human beings and trees.

Cavities in trees are common even in some of the best kept gardens and will always follow the unskilled pruner or the neglected wound. The cavity in itself is not important unless it be a large one, but it is the breeding place which it affords for enemies such as insects and fungi that is highly important and worthy of the most serious consideration in the care of trees. The accumulation of moisture and the exclusion of light and cold which are characteristic of every cavity are the ideal conditions which the spore of a fungus disease seeks. The spores are produced by the millions on all trees attacked by fungi and it is therefore not the least surprising to find that every tree cavity is dangerously exposed to the attacks of fungi and that when a fungus spore does settle in one of these cavities it germinates rapidly under the favorable conditions of food, water, air and warmth, and soon produces a mass of fibers which penetrate the body of the tree. The weakened vitality of the tree, together with the open cavities, will then invite the entrance of many injurious insect pests, so that within a comparatively short time the death of the tree will become inevitable.

A timely cleaning and filling of the cavity, however, would exclude the conditions necessary to the development of disease

and would prevent the entrance of new insects and fungi and stop the disease already started from spreading. The filling of a cavity in most cases involves as many problems as the filling of a tooth and does not mean mere stuffing of the cavity with some solid substance. The one about to fill a cavity must know whether the disease has permeated the whole tree or is still in its first stages. He must know whether the disease prefers dead wood or live wood, or both; whether it is apt to attack the neighboring trees of another species, and whether it is preferable to sacrifice the whole limb or tree instead of filling it. He must be able to recognize the presence of the fungus fibers in order to know when to stop cutting into the cavity, and he must know how to destroy the various insect enemies found within the cavity. He must know whether the wood is naturally strong and pliable or soft and brash, in order to determine the extent to which he can dig into the cavity with safety. He must judge whether an ordinary filling will hold or whether there is a call for mechanical devices such as tin plates to hold the filling in a swaying young tree, or iron bars to hold it between two split limbs. Finally, a knowledge of the nature of the species and general condition of the tree in question will be serviceable in deciding the future possibilities of the tree after treatment.

Before filling the cavity, all diseased wood is removed from it with the free use of the knife, chisel or gouge. It is far better to enlarge the cavity by cutting out every bit of diseased wood than it is to leave a smaller hole in an unhealthy state, for any trace of disease left within the cavity will continue its destructive work behind the filling and later on destroy the tree just the same as if there had been no filling at all. Where there are boring larvae or beetles within the cavity, their destruction must be assured before filling is commenced. It frequently happens with large cavities and hollow trunks that the borers are so situated that they cannot be reached individually; in such cases a method of fumigating the cavity has been resorted to by the writer which consists in closing all orifices leading to the cavity with tar paper and then filling it with vapor of hydrocyanic acid gas or that of carbon bisulfid. Either of these gases will kill all animal life and will penetrate the extreme burrows which the operator's syringe

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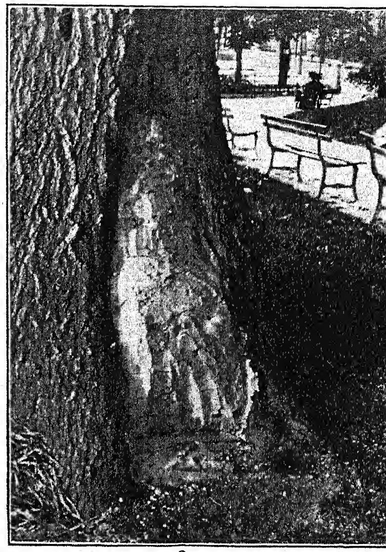

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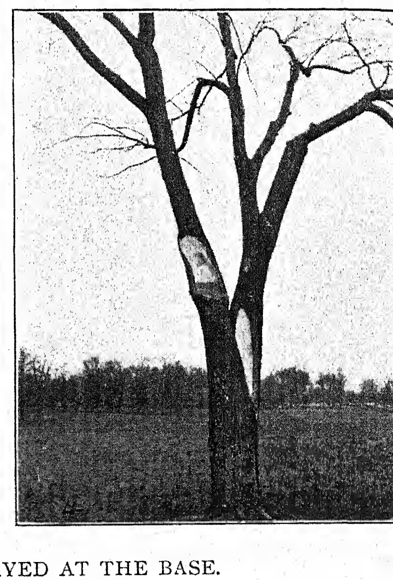


1. AN OAK TRUNK PARTIALLY DECAYED AT THE BASE.
2. THE SAME TRUNK PROPERLY CLEANED OUT AND FILLED.
3. ANOTHER PARTIALLY DECAYED OAK TRUNK IMPROPERLY FILLED.
4. AN ELM WITH LARGE CAVITIES CLEANED AND FILLED.

could never reach or which would otherwise escape his eye. When the cavity is absolutely freed from disease and insects its interior is covered with a coat of white lead paint, which acts as a disinfectant and also helps to hold the filling. The cavity is then solidly filled with bricks, stone and cement, or with charcoal, bricks and cement. The filling is allowed to set and harden and after a day or two covered with coal tar to prevent the weather from cracking the cement. The work can best be done in warm weather. The cement is used mixed with two thirds fine sand, and not only serves as a bed for the bricks and stone but also forms the outer wall of the filling. The exposed face of the filling must not be brought out to the same plane with the outer bark of the tree, but should rather recede a quarter of an inch, so that the living layer or cambium, which is situated immediately below the outer bark, can grow over the cement and cover the whole cavity, if it be a small one, or else grow out sufficiently to overlap the filling and hold it as a frame holds a picture. The growth of this living layer can be much accelerated by cutting around the border of the orifice immediately before the season of growth commences. The substitution of charcoal for a portion of the bricks or stone is advisable in many instances because the coal acts as an antidote against fungi and as an absorbent of moisture. Where a cavity runs down a limb or trunk perpendicularly, a mixture of pitch and sand can be poured down with advantage in place of cement and bricks.

The handling of cavities in this manner is not practiced very extensively in this country, chiefly because the work is not usually done properly and the resulting failures discourage the operators. The cavity is generally not sufficiently cleaned and the disease is allowed to continue its disastrous work behind the filling. The cement is flushed out to the surface of the bark so that within a year or two it either falls out altogether or else is pushed out by the growing cambium forming crevices between the cement and the wall of the cavity. The outer surface of the filling is seldom tarred and is therefore directly exposed to the injurious effects of the weather. The correct method of filling tree cavities has been practiced extensively in Brooklyn for the past two years with excellent results.

BROOKLYN PARK DEPARTMENT.

NEWS AND NOTES

Twenty species of the order Hypocreales are reported by Mr. F. J. Seaver (Bull. Torrey Club 35: 527. 1908) for the state of North Dakota. Of these, one is probably recorded for North America for the first time.

Contribution number 35 of the botanical department of Iowa State College of Agriculture and Mechanic Arts (reprint from Proc. Iowa Acad. Sci. 14: 1–34. 1908) contains a monograph of the Iowa Erysiphaceae by Mr. J. B. Anderson. Twenty-four species and four varieties are recorded for the state.

Mr. F. D. Kern, of the Indiana Experiment Station, in a synopsis of the work done on the genus *Gymnosporangium* (Bull. Torrey Club 35: 499. 1908) records eighteen species for North America, three of which, *G. Davisii* Kern, *G. exiguum* Kern, and *G. floriforme* Thaxter, are described as new. In this paper three new combinations are also made.

Dr. N. Patouillard, in an article on new or little-known fungi (Bull. Soc. Myc. de Fr. 24: 1–12. 1908), describes eighteen new species from various localities, among them *Heterochaete sublivida, Exidia olivacea, Hypochnus Langloisii, Pseudofavolus auriculatus, Xantochrous Ludovicianus* and *Xantochrous fusco-velutinus* from Langlois' collections in Louisiana, and *Tomentella aurantiaca, Leucoporus dictyoporus, Rosellinia Pepo, Leptothyrium glomeratum* and *Septoria Riviniae* from specimens collected by Duss in Guadeloupe.

M. Peltereau gives some valuable notes on various species of *Russula* in a recent article entitled "Etudes et observations sur les Russules" (Bull. Soc. Myc. de Fr. 24: 95–120. 1908), reserving a more complete treatment of this difficult group until some future time.

An article by M. Biers (Bull. Soc. Myc. de Fr. 24: 189–196. *pl. 11–14.* 1908), on the cultivation of the ordinary mushroom in underground galleries in Paris and other French cities, deals with the subject in a popular way, the illustrations adding much to the interest and value of the article.

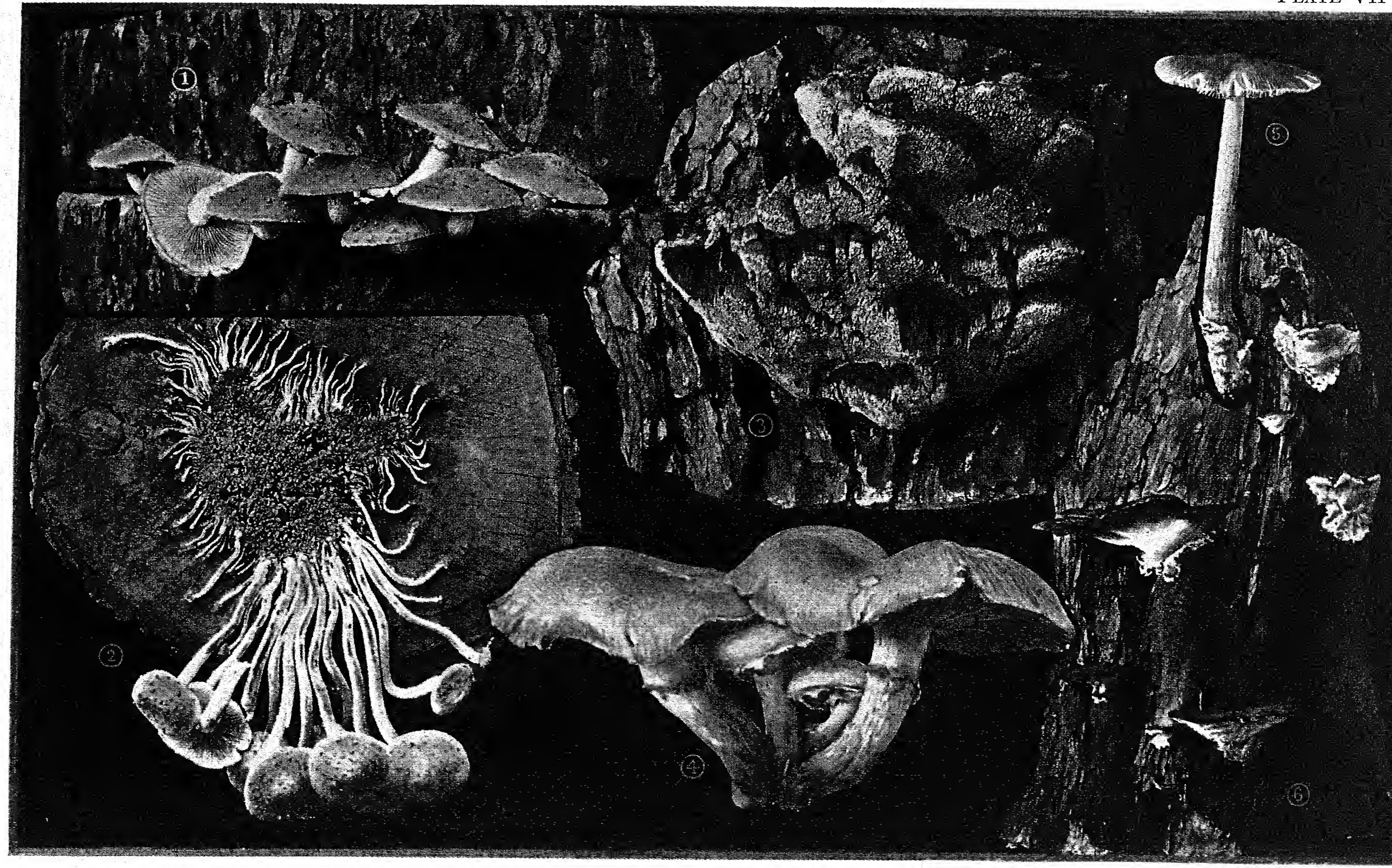
The standing committee on education of the Botanical Society of America, in its fourth report on the college entrance course in botany, recommends the following types for the study of fungi: *Bacteria, Rhizopus* or *Mucor,* yeast, *Puccinia* (or powdery mildew), corn smut, mushroom, *Physcia* (or *Parmelia,* or *Usnea*).

The destruction of the stinkhorn, *Phallus impudicus,* in a small grove where the odor of the mature sporophores became objectionable, was successfully attempted in France by G. de Coutouly, who briefly describes his method in a recent article (Bull. Soc. Myc. de Fr. 24: 181, 182. 1908). At the first appearance of a young sporophore, the soil was removed for a foot or more about the spot where it appeared and the space filled with quick-lime, which killed the mycelium. By following up this treatment, the grove was entirely freed of the fungus in question. Credit for the idea is given to a Bavarian forest ranger, who used lime to exterminate as many as possible of the poisonous species of *Amanita.*

An important paper by F. S. Earle, on the Genera of the North America Gill Fungi, appeared as an advance separate from Bulletin No. 18 of the New York Botanical Garden in January, 1909. It contains a list of generic names used in the group, with their types, and a key to the tribes and genera, with a technical description of each. Of the 147 genera included, 38 are proposed by the author as new, and many others are adopted from previous authors under the law of priority. *Cantharellus* is shown to be antedated by *Alectorolophoides, Schizophyllum* by *Hyponevris, Pleurotus* by *Crepidotus, Clitopilus* by *Orcella, Panaeolus* by *Campanularius, Tricholoma* by *Monomyces, Anellaria* by *Panaeolus, Armillaria* by *Spaerocephalus, Volvaria* by *Pseudofarinaceus,* and *Amanitopsis* by *Vaginata.*

A few of the new genera proposed are: *Glococybe,* based on *Lactarius insulsus; Lactarelis,* on *Russula nigricans; Dixophyllum,* on *Russula furcata; Scorteus,* on *Marasmius oreades; Omphalopsis,* on *Omphalia Campanella; Basidopus,* on *Mycena epipterygia; Collybidium,* on *Collybia velutipes; Monodelphus,* on *Clitocybe illudens; Amanitella,* on *Amanita farinosa;* and *Venenarius,* on *Amanita muscaria.*

A disease of New Hampshire apples, which has been studied by Professor Charles Brooks, of New Hampshire College, is fully described and illustrated in a recent number of the Bulletin of the Torrey Botanical Club (35: 423–456. *pl. 29–35.* 1908). This disease, known as "Fruit Spot of Apples," is caused by a fungus described by Professor Brooks as *Cylindrosporium Pomi.* The fungus gains entrance to the intercellular spaces of the tissue of the apple through the stomata and causes reddish spots, which later become brown or blackish and slightly depressed. Chlamydospores and sclerotial masses of the fungus are the probable agencies for carrying the disease through the winter. Spraying with Bordeaux mixture is a preventative, the application to be made as late as June or July.



ILLUSTRATIONS OF FUNGI

MYCOLOGIA

VOL. I MAY, 1909 No. 3

ILLUSTRATIONS OF FUNGI—III

WILLIAM A. MURRILL

Most of the species here figured belong to the large and important class of wood-destroying fungi, which are of special interest to the forester. While none of them are poisonous, most of them are too tough to be used for food. *Amanitopsis vaginata,* the only species described here that is not generally found on wood, must be carefully distinguished from the deadly species of *Amanita* when collecting it for the table.

Pholiota adiposa (Fr.) Quél.

FAT PHOLIOTA

Plate 7. Figures 1 and 2. $\times \frac{1}{4}, \frac{1}{5}$

Pileus firm, fleshy, convex to expanded, incurved at the margin, 4–7 cm. broad; surface very viscid when moist, shining when dry, lemon-yellow to egg-yellow, with conspicuous bay or testaceous scales, which often become darker, especially near the tip; flesh white or yellowish, almost tasteless, not poisonous; gills adnate, close, pale yellow or isabelline, becoming ferruginous; spores ellipsoid, smooth, ferruginous, $7–8 \times 5\,\mu$; stem subequal, white or yellowish above, slightly darker below, squamose below the delicate, floccose annulus, 5–10 cm. long, 5–8 mm. thick.

This species is conspicuous and quite common in autumn in dense clusters on dead trunks and stumps of deciduous trees, in Europe and North America. It is rarely eaten, because of its

[MYCOLOGIA for March, 1909 (1: 37–82), was issued 15 Ap 1909.]

slimy cap and almost tasteless flesh, but the caps can be easily peeled, and they are readily digested when young and fresh. The illustrations are made from specimens grown between sections of poplar trunks placed for several months in the basement of the museum building of the Garden. By separating the sections, an excellent view, as seen in figure 2, was obtained of the early stages of the young sporophores, as they grew outward toward the light from the fruiting mycelium near the center of the trunk.

Inonotus dryophilus (Berk.) Murrill

OAK-LOVING INONOTUS

Plate 7. Figure 3. $\times \frac{1}{3}$

Pileus thick, unequal, unguliform, subimbricate, rigid, 7–8 × 10–14 × 2–3 cm.; surface hoary-flavous to ferruginous-fulvous, becoming scabrous and bay with age; margin thick, usually obtuse, sterile, pallid, entire or undulate; context ferruginous to fulvous, zonate, shining, 3–10 mm. thick; tubes slender, concolorous with the context, about 1 cm. long, mouths regular, angular, 2–3 to a mm., glistening, whitish-isabelline to dark fulvous, edges thin, entire to toothed; spores subglobose, smooth, deep ferruginous, 6–7 μ; cystidia scanty and short; hyphae deep ferruginous.

This rare species occurs only upon oak trunks, and has been previously reported from Virginia, Wisconsin and three intermediate states. The accompanying figure was made from a rather abnormal specimen found last autumn in Bronx Park on a living white oak. The trunk of this tree was evidently attacked by the fungus from the base up to a height of fifteen or twenty feet, or more, as indicated by the appearance of the sporophores at points where dead limbs had been removed. The white oak is an exceedingly valuable tree, and any fungus that attacks it, even though rare, is of importance to the forester.

Pholiota lutea Peck

YELLOW PHOLIOTA

Plate 7. Figure 4. $\times \frac{1}{2}$

Pileus thick, fleshy, firm, convex to nearly plane, 5–10 cm. broad; surface silky, squamulose near the center, flavous to

luteous, margin sterile and slightly incurved; flesh yellowish, of pleasant odor but bitter taste; gills adnexed to somewhat decurrent, yellowish to deep ferruginous; spores ellipsoid, ferruginous, $9 \times 5\,\mu$; stem 5–7×0.6–1 cm., solid, firm, ventricose, fibrillose, concolorous below, nearly white above; ring rather large and conspicuous, soon colored by the copious spores.

This species is very handsome, occurring in conspicuous clusters on dead trunks in woods from August to October. Although separated from the European species *Pholiota spectabilis* by Professor Peck in 1898, it is very closely related to that species and might be considered only a variety of it by some authorities. Both species are considered very rare in this country. The illustration was made from specimens collected near Bronx Park by Mr. E. C. Volkert, September 24, 1908, and determined by Professor Peck. Another specimen was brought in last fall from Forked River, New Jersey, by Mr. W. H. Ballou.

Amanitopsis vaginata (Bull.) Roze

SHEATHED AMANITOPSIS

Plate 7. Figure 5. $\times \frac{1}{2}$

Pileus thin, fragile, companulate to expanded, 3–8 cm. broad; surface dry, glabrous, deeply striate on the margin, exceedingly variable in color, ranging from nearly white to reddish-brown; gills free, fragile, white; spores globose, smooth, hyaline, 8–$10\,\mu$; stem nearly equal, scarcely enlarged below, glabrous or adorned with minute scales, variable in color, hollow or stuffed within, 6–12 cm. long, 4–8 mm. thick, entirely devoid of a ring, but conspicuously sheathed at the base with a long, loose, white volva, portions of which are sometimes carried up as patches on the cap.

This attractive and very variable species is abundant in woods throughout Europe and North America during summer and autumn, and possesses excellent edible qualities. It may be distinguished from species of *Amanita*, some of which are deadly poisonous, by the total absence of a ring on the stem, although the conspicuous volva at the base suggests its close relationship to that genus. The variations in color presented by this species are often very bewildering to the beginner.

Ischnoderma fuliginosum (Scop.) Murrill

SOOTY ISCHNODERMA

Plate 7. Figure 6. $\times \frac{1}{10}$

Pileus very large, subimbricate, laterally connate, effused-reflexed, often covering the entire under surface of logs, the reflexed portion applanate, 5–15 cm. long, 10 to many cm. broad, 1–2.5 cm. thick; surface pelliculose, floccose, rugose, zonate, fuliginous, ivory-black and dark fulvous, with a conspicuous resinous appearance; margin acute, concolorous, inflexed on drying, entire or undulate; context fleshy, becoming corky with age, very firm and rather fragile when dry, light brown, 5–10 mm. thick; tubes pallid to umbrinous, 5–8 mm. long, mouths minute, white, angular, equal, becoming umbrinous and somewhat irregular with age, edges thin, fimbriate to lacerate; spores smooth, cylindrical, subcurved, hyaline, $4–6 \times 1.5–2\,\mu$.

This species is rather common throughout the United States and Europe, occurring on stumps and fallen trunks of basswood, maple, fir, spruce, and certain other trees. When young it is rather fleshy, but soon becomes corky, and is always too tough for food. There is no evidence that it attacks living trees, but it runs rapidly over the under side of large logs, destroying the wood. The accompanying illustration was made from specimens growing on an old stump near the Lorillard mansion. Unfortunately, it was necessary to reduce them very much in size.

THE COMPOSITION OF A DESERT LICHEN FLORA*

Bruce Fink

The plants upon which the considerations to follow are based were collected in the vicinity of the Carnegie Botanical Laboratory. The collections and field notes were made by Messrs. J. C. Blumer and V. M. Spalding. The collecting was quite carefully done, and a considerably larger amount of material was examined than the rather short list of species given below would indicate. That the list falls considerably short of the entire lichen flora of the area is indicated by the fact that each collection, after the first, brought to light one or more new forms, though collected at random and including a small number of species. However, lichens collected by persons not well acquainted with lichen species are likely to be the more common, conspicuous and characteristic ones. Therefore, some valuable conclusions can be drawn from the study of these specimens, together with a statement of problems which could be solved only through an exhaustive study on the ground, by one well acquained with lichens and the problems and methods of work in ecology. The list of species is as follows:

1. *Endocarpiscum placodizans* (A. Zahlbr.) Fink.
2. *Heppia deserticola* A. Zahlbr. Bull. Torr. Bot. Club **35**: 300. 1908.
3. *Heppia virescens* (Despr.) Nyl. Syn. Lich. **2**: 45. 1860.
4. *Pyrenopsis Schaereri* (Mass.) Tuck. Syn. North Am. Lich. **1**: 135. 1882.
5. *Collema* sp., sterile.
6. *Synechoblastus coccophorus* (Tuck.) Fink.
7. *Leptogium arizonicum* A. Zahlbr. Bull. Torr. Bot. Club **35**: 299. 1908.

* Contributions from the Botanical Laboratory of Miami University—II.

8. *Acarospora xanthophana* (Nyl.) Fink, Bot. Gaz. 38: 271. 1904.
9. *Acarospora xanthophana dealbata* (Tuck.) Fink.
10. *Acarospora Carnegiei* A. Zahlbr. Bull. Torr. Bot. Club 35: 297. 1908.
11. *Acarospora cervina cinereoalba* Fink, Minn. Bot. Stud. 2: 319. 1899.
12. *Acarospora cineracea* (Nyl.) Hedlund in Litt.
13. *Lecanora muralis* (Schreb.) Tuck. Gen. Lich. 113. 1872.
14. *Lecanora cinerea* (L.) Sommerf. Suppl. Fl. Lapp. 99. 1826.
15. *Lecanora calcerea contorta* (Hoffm.) Tuck. Syn. North Am. Lich. 1: 199. 1882.
16. *Placodium elegans* (Link.) Ach. Lich. Suec. Prod. 102. 1798.
17. *Placodium elegans brachylobum* (A. Zahlbr.) Fink.
18. *Placodium murorum* (Hoffm.) Ach. Lich. Suec. Prod. 101. 1798.
19. *Placodium cinnabarinum* (Ach.) Anzi, Lich. Sondr. 1: 43. 1860.
20. *Placodium amabile* (A. Zahlbr.) Fink.
21. *Placodium lobulatum* (Sommerf.) Fink.
22. *Teloschistes modestus* (A. Zahlbr.) Fink.
23. *Parmelia conspersa* (Ehrh.) Ach. Meth. Lich. 205. 1803.
24. *Physcia* sp.
25. *Buellia lepidastra* Tuck. Syn. North Am. Lich. 2: 90. 1888.
26. *Buellia* sp., near *B. concinna* Th. Fr. Lich. Arct. 232. 1860. (fide Theodor Hedlund).
27. *Dermatocarpon miniatum* (L.) Fr. Syst. Orb. Veg. 259. 1825.
28. *Dermatocarpon peltatum* (Tayl.) Fink.
29. *Dermatocarpon* sp., near *D. compactum* (Mass.) Fink.
30. *Dermatocarpon rufescens* (Ach.) A. Zahlbr. in Eng. and Pr. Pflanzenfam. 1^7: 60. 1907.
31. *Endocarpon Schaereri* (Koerb.) Fink.
32. *Verrucaria fuscella* (Turn.) Ach. Lich. Univ. 289. 1810.
33. *Verrucaria nigrescens* Pers. Ust. Ann. Bot. 14: 36. 1795.

These lichens form a remarkable assemblage of plants. The collectors were asked to find any loosely foliose or fruticose

lichens, but only a single loosely foliose species was sent and not a single fruticose one. Moreover, the loosely foliose lichen sent is especially adapted structurally, as will be noted below. Numbers 3, 5, 6, 7, 28, 30 and 31 were found on the ground and number 24 was collected on the base of a tree trunk in a moist place. These numbers may be omitted from the considerations to follow immediately.

COMPARISONS WITH LICHEN FORMATIONS OF OTHER REGIONS

The other twenty-five lichens of the list were found on rocks and bear a striking resemblance to those of a "*Lecanora* formation of exposed granite."* The lichens of this formation of exposed granite in Minnesota, and those of several other similar formations studied by the writer in the same state, show barely a larger proportion of foliose species than do the lichens of the rocks at Tumamoc Hill. Not only is there this general structural likeness; but when we take into account the difference in latitude and in moisture conditions, it is remarkable that the genera of the list for Tumamoc Hill are largely represented in the formations of the exposed rocks in Minnesota, while there is also a very considerable likeness in the species. Coville and MacDougal give 11.74 inches as the average annual precipitation of moisture at Tucson, during fifteen years of observation;† while the writer found the record for Granite Falls, Minnesota, where the Minnesota lichen formation used in the comparison above occurs, to be 21.83 inches.‡ This difference is doubtless the main one of the factors which give the Arizona region a lichen flora as a whole very different from that of the Minnesota area, but which are not sufficient to produce striking differences between the lichen floras of rocks in the former region and those of the exposed rocks in the latter place. H. Zukal says: "Auch zeigen die an der Südseite an nackten Felsen wachsenden Flechten und

* Fink, Bruce. Contributions to a Knowledge of the Lichens of Minnesota.—V. Lichens of the Minnesota Valley and Southwestern Minnesota. Minn. Bot. Stud. 2: 286–288. D 1899.

† Coville, F. V., and MacDougal, D. T. Desert Botanical Laboratory of the Carnegie Institution. Pub. Carnegie Institution of Washington 26. N 1903.

‡ Fink, Bruce. Op. c. 279.

jene heisser, regenarmer Gegenden und Wüsten den gemeinsamen Charakter der ausserordentlich verdickten Aussenrinde."§ The studies of the present writer in agreement with those of Zukal show that lichen formations of horizontally exposed rocks in regions of average rainfall, as well as those of perpendicular or inclined, southward-facing rocks, may show the same structure as the lichens of the desert rocks.

In connection with the observations of Zukal and related to other statements above and to problems to be considered below, statements of the writer in a paper recently published are of special interest. In the study of the lichen formations of sandstone ripraps,|| it was found that the northward-sloping riprap supported a lichen formation containing quite a proportion of fruticose and foliose species, while the formation of a southward-facing riprap a few feet away was composed almost exclusively of closely crustose and strongly corticate species. The latter formation, like the lichen aggregations of the rocks in the vicinity of the Carnegie Desert Laboratory, shows *Acarospora* commonly present, while the members of this genus were extremely rare on the northward-facing riprap. This northward-facing riprap supported an abundance of *Biatora myriocarpoides*. which was replaced on the southward-facing riprap by *Buellia myriocarpa*, a lichen whose structure protects it better against the drier habitat through the greater tendency toward disappearance of thallus and the better development of such structures as exciple, hypothecium and paraphyses. It is significant that *Biatora*, with its poorly developed exciples, hypothecia and paraphyses, is entirely wanting in the lichens sent from the area about the Desert Laboratory.

General Consideration of Structure

It is well known that the more a thallus is branched or lobed, the more young, tender, growing points are exposed and the greater the amount of transpiration of moisture, other things

§ Zukal, H. Morphologische und biologische Untersuchungen über die Flechten. Sitzungsbericht. kaiserl. Akad. Wien. 14: 1308. O 1895.

|| Fink, Bruce. A Lichen Society of a Sandstone Riprap. Bot. Gaz. 38: 269–279. O 1904.

being equal. One may look through the whole list of twenty-five lichens of the rocks without finding more than four species with conspicuously lobed thalli. These four are *Placodium elegans, Placodium murorum, Lecanora muralis* and *Parmelia conspersa;* and these plants, when compared with lichens of the same species from more moist climates, show, as a whole, a perceptible shortening of the lobes of the thalli. Many lichens having the fruticose habit, as certain species of *Evernia,* can scarcely maintain themselves in open places, where subjected to strong gales, but seek protected habitats, as in dense forests, where they will not be torn from their substrata. Also, these fruticose species are usually conspicuously branched and present much surface and many tender, growing areas to the drying effects of winds and dry atmosphere. It is, therefore, not quite certain after all, until further investigation can be made, whether the restriction of lichens about the Desert Laboratory to closely adnate and poorly lobed or branched forms is wholly due to demand for decrease of surface in contact with a drying environment, or whether it is in part a mechanical response against destruction by being torn from their substrata by desert gales.

In general, the twenty-five lichens collected on the rocks of Tumamoc Hill are protected above by some sort of mechanical device, usually a definite pseudoparenchymatous cortex (and enclosed, dead algal cells), which protects the living algal cells and the fungal hyphae of the medullary layer against the drying effects of high winds and the direct rays of sunlight. Zukal has observed that the cortex is thicker in certain lichens growing in places where exposed more than usual to intense light and dry conditions than in the same species in less exposed positions.* One of the most helpful studies in connection with the present problem would be the comparison of some of the species with lichens of the same species from regions having average conditions of light, moisture, temperature, wind, etc., with respect to development of cortex. This, with a more exhaustive study of the functions of coloring matter in the cortex, would help to determine whether the development of cortex in lichens is, as Zukal thinks, mainly a light relation.†

* Zukal, H. l. c.

† Zukal, H. Op. c. 209. Mr 1896.

PROTECTIVE COLORATION

A remarkable thing about these rock-inhabiting lichens from Tumamoc Hill is the more or less evident development of black lines or spots on the upper surface of every species having a light-colored thallus. These lichens or spots are so numerous on older portions of some of the thalli as to darken, more or less, the otherwise light-colored surface. The lines are most conspicuously developed on some of the thalli of *Acarospora xanthophana* and *Parmelia conspersa,* and it was at first thought that they represented parasitic fungi, but sectioning showed that they do not. Zukal, in his excellent discussion of the protective significance of colors in lichens, speaks of such lines of black as occurring on younger or injured portions of thalli to protect the algal cells from the intense rays of sunlight in hot regions;* but the writer found the lines and spots better developed over older portions of thalli and noted that they were frequently developed in connection with cracks in the thalli; nor were the algal cells any more numerous, so far as could be determined, under these black areas than elsewhere in the same thalli. *Parmelia conspersa, Acarospora xanthophana* and *Lecanora muralis* all showed more or less of black margins, which doubtless protect the younger and more tender algal cells of these margins where the cortex is still thin. It was thought that in some of the areolate forms as *Buellia lepidastra* and *Acarospora xanthophana,* in which the thallus is compound, each areole really representing an independent development, the black lines might have been developed at first along the margins and become dorsal by subsequent growth of the areole; but, were this the case, the lines would be as numerous on younger as on older portions of thalli. Besides the species mentioned above, these lines and spots were readily noted in *Acarospora xanthophana dealbata, Acarospora cineracea, Lecanora cinerea* and *Lecanora calcarea contorta.* In section, under the microscope, the upper surface of older portions of some thalli showed the coloring matter often quite generally distributed; whereas under the hand lens it was only apparent where best developed as the black lines or spots, the protective coloration

* Zukal, H. Op. c. 218–221. Mr 1896.

apparently developing gradually from these centers with continued exposure and thus being more abundant in older portions of the thalli.

The isidioid branches were unusually well developed in *Parmelia conspersa* from the desert; and while these branches, of course younger than the horizontal thalli on which they developed, showed only slight and occasional development of the dark lines, they usually showed a brownish coloration at their exposed and tender, growing tips, after the manner of coloration of the tips of branches in many fruticose thalli, which is doubtless protective. *Placodium elegans* showed more or less of the development of darker areas in lighter thalli of the species; but it was not noted in any other thalli of general dark color, these thalli having sufficient coloration of the general surface for protection against intense rays of light in the desert. Nor was it noted that the thalli of any of the twenty-five species were otherwise more deeply colored than lichens of the same species from other regions, except through the development of the black areas and spots, which we must conclude are a protective device.

A very instructive study would be the observation of the relation of development of the black areas to the position of the particular plant on the rocks with reference to the sun's rays. Another problem of interest would be the study of the relation of development of coloration at the tips of the branchlets in *Parmelia conspersa* to the orientation of these branchlets with reference to the sun's rays.

SERIATIM CONSIDERATION OF STRUCTURE

We may now consider *seriatim* the structure of the thalli in the genera most frequently seen in the collections sent for study. *Endocarpiscum* is pseudoparenchymatous throughout, and the algal cells within are thus well protected against too intense light or too much transpiration of moisture, or both. *Acarospora* is also cellular throughout, so that the algal cells are unusually well protected for such small thalli. Like most other lichens whose thalli contain blue-green algal cells, *Endocarpiscum* seems to be confined to the most moist situations in the

area, in spite of its special protective devices. Species of *Acarospora,* on the other hand, form a large proportion of the list of twenty-five lichens of the rocks and are more often seen on rocks closely examined than those of any other genus. Perhaps *Acarospora xanthophana* is the most common lichen in the area studied, though the less conspicuously colored *Acarospora Carnegiei* may prove more common on close examination in the region. *Lecanora* has either an upper cellular cortex or a pseudocortex of entangled hyphae, and *Placodium* shows a similar structure. The one *Parmelia* is a very closely adnate species, which the writer has observed to possess a stronger cortex than the closely related *Parmelia caperata,* which usually grows in less xerophytic conditions. *Buellia* shows the special responses to need of protection in the well-developed exciples, hypothecia and paraphyses, which make its existence possible in the dry environment, while *Biatora,* closely related but less favored in these three respects, is entirely absent or so rare as to be entirely overlooked in collecting. *Buellia* has no cellular cortex above, and the algal cells and the surrounding fungal hyphae are protected above only by a thin pseudocortex of entangled hyphae. *Dermatocarpon* is well protected by strong cortices; and *Dermatocarpon miniatum,* the only species not closely adnate, is attached to the rocks by a very strong umbilicus, while the lower cortex is so strongly developed that no ordinary wind can tear the plants from the rocks. This plant is also able to maintain itself more effectively because tough and elastic like rubber when wet, so that, though pliable before the wind in this condition, it is scarcely more likely to be torn loose when wet than when dry. *Pyrenopsis, Endocarpon,* and the two species of *Verrucaria* were rarely seen in the collections and need not be considered important floral elements.

THE STATIONS

The lichens sent for study were collected from seven stations. Station I is the bottom of the gulch a short distance west of the Desert Laboratory, altitude 762 m. The gulch runs northwest, and the lichens of the rocks were collected from rocks facing northward on the west side of the gulch. The lichens of

the rocks of the gulch are nearly all on the west side or near the bottom. This peculiar distribution is doubtless largely due to the fact that the rock faces of the east side of the gulch receive the direct rays of the afternoon sun. The lichens sent from the rocks of this station are numbers 8, 10, 12, 13, 15, 16, 17, 19, 20, 22, 23, 26, 27, 32 and 33 of the list of species given above. The lichens found on the soil of the bottom of the gulch are numbers 6, 7 and 31. The rocks forming the walls of the gulch are basaltic.

Station II is a mass of basaltic boulders, forming a cliff facing southward on the south side of Tumamoc Hill, altitude 792 m. The collection was made from all sides of the boulders; and Mr. Blumer reported the south faces of the boulders to be very poor in lichen species and individuals, while the lichen flora is best developed and most highly colored on the north faces of the boulders. The lichens determined from this station are numbers 1, 2, 8, 10, 11, 12, 13, 16, 17, 19, 20, 21, 23, 26, 27 and 32. The similarity between the lichen species of the basaltic rocks of the first two stations will be apparent enough upon noting the similarity in numbering, and especially when one takes into account the genera represented by these numbers as well as the species. Mr. Blumer's notes regarding station II state that a number of moisture-requiring seed-plants, such as *Celtis pallida, Abutilon incanum, Encelia farinosa* and a *Eupatorium* grow about the rocks; and doubtless there are moist places on the rocks where numbers 1 and 2 grow. At least, the writer has found members of the genus *Endocarpiscum* growing in moist places elsewhere. The structural responses of the other lichens found in the first two sections were sufficiently considered in the general and in the *seriatim* statements of adaptations and need not be repeated.

Station III is a very steep slope facing directly south on the south side of Tumamoc Hill, altitude 823 m. The lichen habitat consists of loose blocks of tuff and basalt, especially the former, which have worked down from a quarry above. The habitat is a very dry one, and nothing exists on the ash-dry soil except a few bushes of *Larrea tridentata*. The lichens determined from this station are numbers 8, 9, 10, 11, 12, 13 and 16. The meagerness of lichen species here is very apparent, but it is not certain

whether this meagerness is due to the presence of the tuff or to the southern exposure. Mr. Blumer stated in a letter that the lichens seem to grow better on the basalt, but only one of the stations reported is composed entirely of tuff, so the question of relative suitableness of the two kinds of rocks for lichen substrata cannot be certainly solved from data at hand. Mr. Spalding and Mr. Blumer both stated in letters that lichens are very scarce on southward-facing rocks, the latter gentleman writing: "Their place of best development is on the northerly faces of basaltic rocks, where they are often beautifully conspicuous. On sunny aspects of rock faces they must be looked for to be found." However, the most remarkable thing about the short list of seven lichens found in this station is that five of them belong to the genus *Acarospora,* and that every species and subspecies of the genus known to occur on Tumamoc Hill is found in this one station. The writer must again refer to his work in Minnesota,* where he has found the genus represented in every one of the six lichen formations of exposed horizontal rocks studied, whether on granite, quartzite or pipestone, and in all but one by the species *Acarospora xanthophana.* Also, he must recur to his statement, in the paper on "A Lichen Society of a Sandstone Riprap,"† regarding the frequent occurrence of *Acarospora* on the southward-facing riprap and its very rare occurrence on the northward-facing riprap a few feet away. These data, with those of station III, establish beyond doubt that *species of Acarospora, with their strong protective cortices and their cellular structure throughout are the most characteristic xerophytes of all our American lichens thus far studied from the ecologic point of view.* They occur in xerophytic associations as a small proportion of the plants of lichen formations in exposed environments in regions for the most part mesophytic, and are found at station III making a very large proportion of a lichen aggregation on the southward-facing, dry and often hot rocks of a desert region.

Station IV is in the same locality as station II, but differs in that it is an outcrop of tuff facing eastward at the bottom of the exposure. The plants determined from this station are numbers

* Fink, Bruce. Op. c. and other papers of the same series.

† Fink, Bruce. Op. c. 278.

1 and 2 of the list. The eastward-facing tuff at the bottom of the exposure is doubtless often moist, so that *Endocarpiscum* finds a favorable habitat. It is not a little remarkable that the tuff, even at the base of the exposure, gave only two lichens; and, while it can hardly be possible that the absence of other lichens from the formation is more than a singular accident in distribution, if indeed the collecting was in this instance carefully done, the data at hand tend strongly to prove that tuff is a very poor substratum for lichens.

Station V is a northward-facing basalt cliff on the north side of Tumamoc Hill, just west of its summit, altitude 914 m. Mr. Blumer thinks that this is perhaps as moist and cool a place as can be found about the Desert Laboratory, but he writes that even here lichens are absent from certain rock crevices and faces that are perennially dry, and are for the most part limited to such surfaces as are frequently wet or moist. The lichens found in this station are numbers 6, 7, 8, 10, 13, 15, 16, 19, 23, 26, 27, 30 and 33. The general similarity of this list of lichens and that of station I is apparent enough from the numbers, and it need only be stated that the gelatinous lichens which commonly grow in moist and shaded habitats are represented on the rocks here by numbers 6 and 7. This comparatively moist and cool station is the only one at which these species were found upon the rocks. The failure to get *Endocarpiscum* from this station is doubtless due to an oversight in the collecting.

Station VI is at the bottom of the gulch west of the Desert Laboratory, on the north slope, about an old tuff quarry, altitude 747 m. The rocks are tuff, with a few basaltic boulders, and the station is drier than station V. The lichens found in this station are numbers 3, 4, 8, 9, 10, 11, 13, 15, 16, 17, 18, 19, 23, 26 and 33. The general similarity of this lichen assemblage to that in station I is readily seen. The present station shows a larger number of species of *Acarospora* than did station I, and the individuals of this genus predominate more plainly in the present station, if one may judge by the material sent. The tuff is doubtless a drier rock than the basalt, not holding water so well, and it would seem that is supports a fairly well developed lichen flora on the northward-facing exposures, but not on the southward-facing. How-

ever, station VI contains basalt as well as tuff, and this conclusion can not be regarded as secure until several stations composed entirely of tuff are examined. The prevalence of tuff in the present station doubtless accounts for the drier conditions which have given species of *Acarospora* in greater numbers.

Station VII is the north face of a basalt block near the Desert Laboratory. The lichens determined from this station are very similar to those from stations I and VI, and a consideration of them would add nothing of value.

LICHENS OF SOIL AND TREES

At all of the stations an effort was made to find lichens on the soil. At stations II, III, IV, VI and VII nothing was found on the earth, while from stations I and V were found numbers 5, 6, 7, 28, 30 and 31. Mr. Blumer stated that the lichens collected at station V were found on wet soil, nothing appearing to the eye on dry soil. Inconspicuous lichens are much more easily visible when moist, and this fact may account for the difference in appearance, but Mr. B. E. Livingston has found that the soil becomes air-dry for a considerable depth during dry seasons,* and it is more probable that the lichens of the soil, whose short rhizoids penetrate but a small portion of the distance down to soil moisture in drier situations, are for the most part confined to shaded places where the moisture is retained longer and where it is doubtless drawn upward along the faces and crevices of the rocks extending into the soil, so that the lichens can get more moisture from below than they could get by evaporation through the air-dry layer of soil above the caliche in drier places. A thorough study of the earth-inhabiting lichens of the region should be made, however few may be the number of species found, for the sake of the light that would be thrown upon general ecologic problems.

The lichen flora of the woody plants of the area must be very limited, for repeated requests for such material brought nothing but a few sterile and poorly developed specimens of a *Physcia* and a *Placodium*. These were collected on *Parkinsonia microphylla*, very close to the ground, among rocks on a north slope.

* Livingston, B. E. The Relation of Desert Plants to Soil Moisture and to Evaporation. Pub. Carnegie Institution of Washington, 8. Au 1906.

RELATIONS TO MOISTURE AND AIR MOVEMENTS

It still remains to discuss several factors which influence lichen distribution in the area under consideration and at the same time to state several further problems that may well receive attention at some future time. Regarding the atmospheric conditions likely to influence lichen distribution, relative humidity and air movements are doubtless the most important factors. The relative humidity is known to be as low as eight per cent. of saturation about the Desert Laboratory, at times of special dryness in summer, and it varies from this to a high relative humidity during the rainy seasons. The ordinary winds blow from the east in the morning, later from the south, and by the middle of the afternoon from the west, while the gales may come from any direction. The drying winds from the east, south and west, day after day, doubtless interfere somewhat with the development of lichens on these three sides of outcrops of rocks, accentuating the effect of direct sunlight, thus leaving the northward-facing ledges by far the best habitats for lichens.

Mr. V. M. Spalding has shown certain desert seed-plants to absorb more or less water through their leaves and young shoots, some of them as much as nineteen per cent. of their weight,* and has also found that certain species of desert seed-plants absorb a very small amount of water vapor from a nearly saturated atmosphere, through their leaves and twigs.† He thinks that this absorption of water and water vapor through the leaves and twigs may be of some slight advantage.

H. Jumelle has experimented with lichens in somewhat similar fashion, in order to ascertain the amount of dryness of lichens in their habitats.‡ He collected several widely different species from trees and rocks, weighed them, placed them in a desiccator and weighed them again after drying. Jumelle's first experiments were performed upon lichens taken at a time when quite dry and supposed to be in a latent condition, and he found the

* Spalding, V. M. Biological Relations of Desert Shrubs.—II. Absorption of Water by Leaves. Bot. Gaz. 41: 262–282. Ap 1906.

† Spalding, V. M. Absorption of Atmospheric Moisture by Desert Shrubs. Bull. Torr. Club 33: 367–375. Jl 1906.

‡ Jumelle, H. Recherches Physiologiques sur les Lichens. Rev. Gen. Bot. 4: 115. Mr 1892.

relation of fresh weight to dry weight to vary from 1.14 to 1 in *Parmelia acetabulum* to 1.21 to 1 in *Teloschistes parietinus*. He thinks that respiration and assimilation in lichens are reduced to almost *nil* in dry times. He found that *Cladonia rangiferina* and some other higher lichens can endure the dry condition for three months, and, upon the return of moist conditions, the life energies gradually return to their normal condition. Jumelle also experimented with lichens collected at times when they should be near their maximum regarding water content in their natural habitats, and got no very striking increase in the amount of water present in their thalli, the figures for *Parmelia acetabulum* at two different times being 2.07 to 1 and 1.38 to 1. He also dipped lichens into water several times, wiped them carefully and weighed them at once and also after drying. He found that the relation between the saturated weight and the dry weight is for *Parmelia acetabulum* 3.36 to 1, a proportion above the average for nineteen lichens experimented upon by him.

Jumelle has also experimented in similar fashion with seed-plants and has found that the proportion between fresh and dry weight varies from 10 to 1 up to 20 to 1. This shows that lichens, compared with seed-plants, contain very little water at any time, though the former are much more able to absorb water or water vapor in the proportions needed than are the latter, according to the experiments of Spalding. It must be further stated that Jumelle found a *Collema* dipped in water to show the surprising proportion of 35 to 1. He therefore concludes that the gelatinous lichens have a very high absorbing power. But these aside, lichens need very little water and are able to obtain all that is needed through the general surface, instead of through specialized organs as roots; the power of lichens to absorb water and water vapor through the general surface being high as compared with the results obtained by Spalding for the leaves and twigs of certain desert seed-plants. All considered, it may be assumed until otherwise proven, that lichens absorb at least a large proportion of the moisture needed, directly from water vapor of the atmosphere and from water falling upon them. However, so far as the writer can ascertain, the statements made by Jumelle do not rest upon experiments

made upon any desert lichens, and similar experiments with some of the lichens about the Desert Laboratory would certainly give some very instructive results.

Zukal, in summing up regarding the hygroscopicity of lichens, says: "Die Hygroskopicität ist für die Flechten eine höchst wichtige Eigenschaft, und nicht wenigen Arten ermöglicht sie geradezu die Existenz. Dies gilt besonders für die Bewohner jener Gegenden, wo es nur wenige Tage im Jahre regnet, wie dies z. B. in manschen Landschaften Chiles, Australiens und Nordafrikas der Fall ist."* It is doubtless true that hygroscopicity is of very considerable use to the crustose lichens of the deserts; though the most hygroscopic lichens are not the crustose ones, which seem to constitute almost the whole lichen flora of the desert area under consideration, nor yet the closely foliose ones that form a very small proportion of the lichen flora of Tumamoc Hill, but the loosely foliose and the fruticose species, especially those covered with hairs, cilia and free rhizoids. Experiments similar to those of Spalding and Jumelle, performed upon the crustose lichens of the desert in the driest condition in nature and giving the relation between fresh and dry weight, would give data regarding the amount of moisture retained in lichen thalli during the driest times in the desert. Accompanying this should go observations regarding the length of time that these lichens may be kept dry and then resume active respiration and assimilation on the return of favorable conditions.

Lichens can get water from the surface of the ground or rocks for a short time during and after each rain or wet season; but they have no special adaptation for storing water like cacti, nor have they organs extending any considerable distance into the soil or into rock crevices by which, like many seed-plants, they could extract soil moisture from any considerable depth. The retreat of the evaporating surface into the soil therefore leaves any lichens growing upon exposed soil entirely in an air-dry environment; consequently, the ability of these lichens, if lichens exist in such habitat, to absorb both water and water vapor from the atmosphere would be of special use to them in withstanding the effects of prolonged drought. This brings us to the ques-

* Zukal, H. Op. c. 1346. O 1895.

tion of how much moisture the lichens of the rocks in the desert may be able to obtain from upward passage through the rocks. It is well known that rocks are more or less porous and that the pores are larger toward the surface, porosity ranging from less than one per cent. to thirty per cent. or more. C. R. Van Hise states that water may rise 166 meters by capillarity, that, after it has ascended as high as it can by capillarity, it will still, through molecular attraction, creep along the walls of the pores "from areas of greater to areas of less humidity," and that there is no limit to such movement.*

No reliable data are at hand regarding the porosity of the tuffs and basalts of Tumamoc Hill and the amount of water that reaches the surface through them. The basalt is more dense and less porous than the tuff, and the latter may, like the soil, give off moisture so rapidly as to become too dry to support lichens very successfully through periods of prolonged drought. The less porous basalt doubtless gives off water vapor coming up from great depths very slowly, but perhaps in sufficient quantity to keep the lichens growing on these rocks alive in the driest times known in the desert; at least on surfaces often wet during the rainy season, and especially on northward-facing exposures where the effect of prolonged drought is felt least. Mr. Spalding stated, in answer to inquiry, that the lichens seem to be quite as numerous on large boulders as on the rock exposures *in situ*. The boulders do not extend to great depth; but if they extend below the lower limit of evaporating surface in the soil in driest times, the problem of distribution of lichens on them might not differ materially from that of their distribution on other rocks. This question of water supply for the lichens from the rocks below them is well worth investigation at the Desert Laboratory. It is certain that the supply obtained in this way is not alone sufficient to sustain lichens, for observation proves that these plants do not grow on desert rocks perennially dry. But the moisture thus obtained may be sufficient to keep the lichens alive during periods of extreme dryness, in situations where they may obtain moisture otherwise during rains and wet seasons.

* Van Hise, C. R. Treatise on Metamorphism. No. 753. Geol. Surv. Mon. 47: 151. 1904. (House Documents, vol. 83.)

Conclusion

This brief study of the ecologic relations of some desert lichens should be of special interest, since it is the first one to appear. The workers in ecology have very largely confined their attention to seed-plants, but there is certainly a problem of great interest in the study of ecologic distribution of lichens in the desert as well as elsewhere. The writer has been at the disadvantage of not being able to see the field, and had it not been for the painstaking manner in which Mr. Spalding answered all inquiries and the careful collecting and note-taking of Mr. Blumer, the results herein presented would not have been possible. The writer realizes very fully that there are other problems concerning the distribution of lichens in the area herein considered, doubtless of as great importance as the ones discussed or suggested herein, that would present themselves during the progress of a study of the problem in the field.

While the writer was studying the ecologic problems, a number of the lichens collected were sent by him to Mr. Theodor Hedlund and to Mr. A. Zahlbruckner in Europe for aid in the taxonomic study. Thanks are due to both of these gentlemen for their aid in the work. Six new species and one new subspecies result from the work of Zahlbruckner (see Bull. Torr. Club 35: 297–300. Je 1908).

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DISCOMYCETES OF NORTH DAKOTA

Fred. J. Seaver

The following is a list of the discomycetes (cup-fungi) collected and studied in North Dakota during the seasons of 1907–8. When not otherwise indicated the collections were made by the writer.

Hymenium exposed from the first, plants not usually cup-shaped, disc-shaped, boat-shaped or linear. 1. Helvellineae.

Hymenium at first closed, plants cup-shaped, disc-shaped, boat-shaped or linear, opening by a circular, star-like or slit-like aperture.

  Hymenium exposed at an early stage, plants cup-shaped or disc-shaped. 2. Pezizineae.

  Hymenium long, enclosed in a firm covering, opening with a star-like or slit-like aperture.

    Opening for the most part with a star-like aperture. 3. Phacidiineae.

    Opening with a slit-like aperture. Plants boat-shaped or linear. 4. Hysteriineae.

1. Helvellineae

Plant large, consisting of a stem and globose pitted head. 1. Morchella.

2. Pezizineae

Plants small, 1–2 mm. in diameter, forming orange or salmon-colored masses 1–3 cm. in diameter on burnt soil. 2. Pyronema.

Plants not forming confluent masses and not usually occurring exclusively on burnt soil (except a few species not here recorded).

  Externally clothed with dark-colored bristly hairs. 3. Lachnea.

  Externally naked or hairs when present light-colored, usually white.

    Plants large, 1–8 cm. in diameter, cup-shaped, urn-shaped or saucer-shaped.

      Plants stipitate, often attached to sticks in woods.

        Within scarlet, without whitish, slightly hairy. 4. Sarcoscypha.

        Within and without dark brownish-black. 5. Urnula.*

      Plants sessile, on wood, soil, etc.

* Often included with the Phacidiineae.

Juice turning yellow when flesh is broken. 6. GALACTINIA.
Juice remaining colorless. 7. PEZIZA.
Plants medium or small, 1 cm. or less in diameter.
Occurring on dung of animals (except one species which occurs on old paper, cloth, etc., and a few others not here recorded).
Spores entirely colorless.
Asci 8-spored, plants yellowish, cinereous or flesh-colored.
Plants with conspicuous, colorless spines. 8. LASIOBOLUS.
Plants without spines. 9. ASCOPHANUS.
Asci 32-spored, plants white. 10. THECOTHEUS.
Spores colored, at first bright purple, later brown.
Spores free in the ascus. 11. ASCOBOLUS.
Spores united in a ball in the ascus. 12. SACCOBOLUS.
Occurring on wood, herbaceous stems, living leaves, etc.
Plants superficial on the substratum.
Clothed with a dense covering of soft, light-colored hairs.
Plants sessile. 13. TRICHOPEZIZA.
Plants stipitate, stem often slender. 14. DASYSCYPHA.
Not clothed with hairs.
Plants stipitate, stem stout, or slender.
Stem short, stout, plants occurring on wood.
Hymenium bright yellow, disc nearly plane. 15. HELOTIUM.
Hymenium smoky-brown, beaker-shaped. 16. GEOPYXIS.
Stem comparatively long and slender, on herbaceous stems, etc.
Plants small, 1 mm. or less in diameter. 17. PHIALEA.
Plants medium, 3–5 mm. in diameter. 18. CIBORIA.
Plants sessile.
Substance soft and plants not black in color.
Medium, 3–5 mm. in diameter.
Dark purple, rubbery, spores colorless. 19. CORYNE.

Greenish, spores colored, greenish-brown. 20. PHAEOPEZIA.
Small, not exceeding 2 mm. in diameter.
Plants disc-like, on leaves, wood, etc. 21. MOLLISIA.
Plants forming spots on leaves, alfalfa, etc. 22. PSEUDOPEZIZA.
Substance hard, forming black discs on wood, etc.
Spores with transverse septa only.
Spores 1-septate, brownish. 23. KARSCHIA.
Spores more than 1-septate, colorless.
Spores filiform, breaking into joints. 24. BACTROSPORA.
Spores not filiform. 25. PATELLARIA.
Spores muriform. 26. BLITRYDIUM.
Plants formed below the epidermis and bursting through usually in clusters.
Plants medium, 3 or more mm., usually cup-shaped. 27. CENANGIUM.
Plants small, 1–2 mm. mostly disc-shaped. 28. DERMATEA.

3. PHACIDIINEAE

Plants forming light-colored linear patches on old wood, etc. 29. PROPOLIS.

4. HYSTERIINEAE

Plants almost entirely superficial.
Lips spreading so that the plants become subpatellate. 30. HYSTEROPATELLA.
Lips tightly closed or only slightly spreading.
Spores muriform, with transverse and longitudinal septa.
Spores colored brown. 31. HYSTEROGRAPHIUM.
Spores colorless. 32. GLONIOPSIS.
Spores 1-septate, colorless. 33. GLONIUM.
Plants submerged, surface even with surface of substratum. 34. HYPODERMA.

1. HELVELLINEAE

1. MORCHELLA

MORCHELLA ESCULENTA (L.) Pers. A species well known by its stipitate, subglobose, deeply-pitted head. Commonly classed with the mushrooms and much valued for its edible qualities.

Observed by the writer from material collected by one of the students of the Agricultural College.

2. PEZIZINEAE

2. PYRONEMA

PYRONEMA OMPHALODES (Bull.) Fuckel. Forming salmon-colored patches often several cm. in diameter on soil where wood or rubbish has been burned. While the individual plants are small they run together so closely that they present the appearance of one continuous mass which is surrounded by a spider-web-like halo of mycelium. The species was collected often in North Dakota about Sykeston on damp soil where there was no apparent trace of fire, but the places had doubtless been burned over, as the plants are usually restricted to burnt places. Also collected elsewhere on soil which had been sterilized by heating.

3. LACHNEA

LACHNEA SCUTELLATA (L.) Sacc. Saucer-shaped plants as large as 1 cm. in diameter with a bright red hymenium surrounded by a border of dark-colored hairs. On wood and the surrounding soil. Collected at Sykeston.

LACHNEA SETOSA (Nees) Sacc. Occurring often closely crowded on decaying mossy logs in woods. Similar to the preceding but plants one-third as large and hairs much longer. Collected on old box-elder logs in woods near Fargo.

LACHNEA HEMISPHERICA (Wigg.) Gill. Hemispherical plants about the size of a large acorn-cup, growing on moist soil in shaded places in woods. Inside of cup whitish or bluish-white, externally clothed with chestnut-brown, bristly hairs. Collected in woods near Fargo.

4. SARCOSCYPHA

SARCOSCYPHA COCCINEA (Jacq.) Cooke. Plants found in woods in spring attached to partially buried sticks. Inside of cups, which are often 3 cm. or more in diameter, brilliant scarlet, outside whitish and more or less downy with soft white hairs.

One of the most attractive of the discomycetes on account of its brilliant color. Observed from material collected by one of the students of the Agricultural College.

SARCOSCYPHA OCCIDENTALIS (Schw.) Cooke. Habitat similar to that of the preceding but plants occur all summer. Stem usually longer and more slender, cups smaller and shallow, saucer-shaped instead of deep funnel-shaped as in the preceding. Collected commonly in woods about Fargo.

5. URNULA

URNULA CRATERIUM (Schw.) Fries. Occurring in woods on buried sticks, a number of specimens often attached to a single stick. Plants at first club-shaped and entirely closed, finally opening with a star-like aperture and becoming urn-shaped but margin usually notched. Outside and inside dark brownish-black. The position of this species is uncertain but on account of the manner in which the cups open the genus is often included with the Phacidiineae.

6. GALACTINIA

GALACTINIA SUCCOSA (Berk.) Cooke. Plants cup-shaped, rather large, 2–3 cm. in diameter, inside brown, externally whitish. When the flesh is broken the exuding juice turns golden-yellow. Occurring on damp soil in shaded woods. Collected near Fargo.

7. PEZIZA

PEZIZA VESICULOSA Bull. Large cup-shaped plants often 6–8 cm. in diameter, yellowish inside, whitish externally, occurring usually in dense clusters on strawy manure piles and soil fertilized with such material. The cups are at first regular in form, becoming much contorted and twisted. A common species. Collected at Sykeston.

PEZIZA REPANDA Wallr. This species occurs on decaying logs in woods, and, while it resembles the preceding in color, it differs in form, the cups soon becoming repand, leaving the hymenium convex. This is a species concerning which there is much doubt. The specimen collected near Fargo by the writer conforms with

what is usually accepted as this species. The plant was about 6 cm. in diameter.

PEZIZA BADIA Pers. The brown cup-fungus common on moist soil in woods. The specimens collected in Fargo woods were small, about 2–3 cm. in diameter, but the plants of this species often attain a size of 8–10 cm.

8. LASIOBOLUS

LASIOBOLUS EQUINUS (Muell.) Karst. The plants of this species while minute, usually occur in dense masses on dung of various kinds, especially that of horses and cows. The color varies from yellowish to reddish but the plants are always characterized by the thick covering of colorless spines. Collected on dung of horses at Sykeston.

9. ASCOPHANUS

ASCOPHANUS CINEREUS (Crouan) Boud. Plants occurring gregarious or densely crowded on dung of horses, and characterized by the grayish or often nearly black color. Collected on horse dung in a swampy place in open woods near Fargo.

ASCOPHANUS TESTACEUS (Moug.) Phill. Plants flesh-red, usually gregarious or scattered on hemp cloth, building paper, rags, etc. Specimens collected near Fargo were found on building paper near the remains of an old house.

ASCOPHANUS CARNEUS (Pers.) Boud. Similar in color to the preceding but differing in its habitat as well as in morphological characters. Rather a common species on old cow dung. Collected commonly about Sykeston.

10. THECOTHEUS

THECOTHEUS PELLETIERI (Crouan) Boud. Plants white, at first conical, later cylindrical. Common on dung of various kinds and easily characterized by its 32-spored asci, as well as by its gross characters. Collected in woods near Fargo.

11. ASCOBOLUS

ASCOBOLUS IMMERSUS Pers. Plants small and not easily seen as they closely resemble in color the, substratum on which they occur, but often occurring in abundance. Characterized by the asci filled with dark purple spores which project far above the surface of the hymenium. The spores in this species are unusually large. Collected near Sykeston.

12. SACCOBOLUS

SACCOBOLUS KERVERNI (Crouan) Boud. Plants small, golden-yellow, with the hymenium dotted with the ends of the asci containing dark purple spores. A common species on dung of cows. Specimens collected at Sykeston.

SACCOBOLUS VIOLASCENS Boud. Differs from the preceding in that the plants are violet instead of golden-yellow. The species also differs in microscopic characters. Specimens collected at Sykeston on horse dung.

13. TRICHOPEZIZA

TRICHOPEZIZA SULPHUREA (Pers.) Fuckel. Plants small, occurring on herbaceous stems and characterized by a dense covering of sulphur-yellow hairs. Collected at Fargo.

TRICHOPEZIZA TILIAE (Peck) Sacc. Plants small, white, and clothed externally with a dense covering of white hairs. Common and abundant on the bark of dead branches of basswood (*Tilia Americana*). Collected commonly about Fargo.

14. DASYSCYPHA

DASYSCYPHA NIVEA (Hedw.) Sacc. Plants stipitate and clothed with a dense covering of white hairs. Specimens collected on herbaceous stems at Hawk's Nest. The species is common on decaying wood, especially oak.

15. HELOTIUM

HELOTIUM CITRINUM (Hedw.) Fries. Plants very bright lemon-yellow, and usually occurring thickly gregarious on old

wood, and sometimes becoming slightly confluent. Collected in woods near Fargo.

16. GEOPYXIS

GEOPYXIS NEBULOSA (Cooke) Sacc. Plants medium in size, beaker-shaped, smoky-brown. Occurring on decaying logs in woods. The species is distinguished by its fusiform spores. Collected commonly about Fargo.

17. PHIALEA

PHIALEA URTICAE (Pers.) Sacc. Small, pale yellow plants with a slender stem. Collected commonly about Fargo on dead stems of nettle (*Urtica* sp.).

18. CIBORIA

CIBORIA SULPHURELLA (Ellis & Everh.) Rehm. Plants medium, stipitate, stem often very long or very short according to depth at which the substratum, petioles of ash leaves, is buried under leaves and soil. This species has been observed by the writer not only in North Dakota but commonly in Iowa and New York and apparently grows wherever the ash is found. The plants are very variable in color, ranging from sulphur-yellow or yellowish-green to reddish-brown. Collected at Hawk's Nest and Fargo.

19. CORYNE

CORYNE SARCOIDES (Jacq.) Tul. Often growing in clusters from crevices in decaying logs. Of a purple color and often very dark, with the substance inclined to be tough or rubbery. A common species. Collected near Fargo.

20. PHAEOPEZIA

PHAEOPEZIA FUSCOCARPA (Ellis & Holw.) Sacc. Plants saucer-shaped or disc-shaped, occurring on the under side or near the soil on rotting logs, dark colored with a shade of green, The spores of the species are also green, becoming brown. Collected in woods near Fargo.

21. MOLLISIA

MOLLISIA CINEREA (Batsch) Karst. Plants small or medium, saucer-shaped, with a light-colored border. Common on wood and decaying herbaceous stems. Collected commonly about Fargo. The specimens occurring on herbaceous stems may be distinct from those on wood but we can see no difference.

MOLLISIA DEHNII. Rabenh. On living leaves and stems of *Potentilla* sp. The plants, when they occur, almost entirely cover the leaves and stems of the host. They are small and disc-shaped and of a rather dark color. Collected at Fargo in the Agricultural College grounds.

22. PSEUDOPEZIZA

PSEUDOPEZIZA MEDICAGINIS (Lib.) Sacc. Forming minute brown leaf-spots on the living leaves of the host and causing much damage to the crop. Collected commonly at Fargo in the Agricultural College grounds, on leaves of alfalfa.

23. KARSCHIA

KARSCHIA TAVELIANA Rehm. Forming small black discs, often in considerable numbers, on partially decayed wood. Collected about Fargo on logs of decaying ash.

KARSCHIA LIGNYOTA (Fries) Sacc. Similar to the preceding but smaller and spores also different. Collected on old wood at Hawk's Nest.

24. BACTROSPORA

BACTROSPORA DRYINA (Ach.) Mass. The genus is represented by a single species, and no previous record of it has been seen from North America. Specimens collected on dead branches of *Symphoricarpus occidentalis*, by J. F. Brenckle, at Kulm, N. D.

25. PATELLARIA

PATELLARIA ATRATA (Hedw.) Fries. Plants similar in external appearance to those of the preceding genus but very different internally. Spores much larger, colorless and many-septate. Substance with transmitted light bluish. Hawk's Nest.

PATELLARIA CLAVISPORA (Peck.) Sacc. This species is very common on bark and wood of willow and cottonwood. The spores are very different in form and color from the preceding. Collected about Fargo.

26. BLITRYDIUM

BLITRYDIUM FENESTRATUM (Cooke & Peck) Sacc. Plants similar to those of the two preceding genera but spores much larger, broader, brown, and divided by both longitudinal and transverse septa, becoming muriform. Collected commonly on the bark of dead twigs of *Populus tremuloides,* in woods near Fargo.

27 CENANGIUM

CENANGIUM FURFURACEUM (Roth.) DeNot. Plants forming cespitose clusters bursting through the bark of the host. Collected commonly about Fargo on dead branches of *Corylus* sp. The cups remain for a long time closed, finally opening and becoming cup-shaped.

28. DERMATEA

DERMATEA sp. A species of this genus was collected in great abundance on dead branches of *Amelanchier* sp. in woods at Hawk's Nest. The species is still undetermined.

3. PHACIDIINEAE

29. PROPOLIS

PROPOLIS FAGINEA (Schrad.) Karst. Forming white lines often 1 mm. wide and several mm. long on old wood. The white surface constitutes the hymenium of the plant, which consists of asci, paraphyses and spores. Collected commonly in woods near Fargo.

4. HYSTERIINEAE

30. HYSTEROPATELLA

HYSTEROPATELLA PROSTII (Duby.) Rehm. Plants boat-shaped, and intermediate in form between *Patellaria* and *Hysterium,* the plants being at first hysteriform and later becoming subpatellate. Collected near Fargo.

31. Hysterographium

Hysterographium Mori (Schw.) Rehm. Plants linear, opening with a slit-like aperture, spores muriform, brown. Common on old wood of various kinds. Collected on old oak wood near Fargo.

Hysterographium Fraxini (Pers.) DeNot. A very common and abundant species on bark and wood of ash. Dead branches still on the tree are often nearly covered with the small, boat-shaped plants. Very different from the preceding. The species has also been collected on *Xanthoxylum*.

32. Gloniopsis

Gloniopsis Gerardiana Sacc. The species of this genus differ from those of the preceding in that the spores are colorless instead of brown. Collected on old oak wood, near Fargo.

33. Glonium

Glonium stellatum Mühl. Plants forming black stellate masses on old wood, the individual plants linear, opening with a cleft. The first appearance is a dense mass of black mycelium.

Glonium parvulum (Gerard) Sacc. Plants very small and parallel with each other, often occurring in great numbers and rather closely crowded. Collected on old stumps in woods near Fargo.

Glonium lineare (Fries) DeNot. Plants larger than the preceding and differing in spore characters. Collected on wood at Hawk's Nest.

34. Hypoderma

Hypoderma scirpinum DC. Plants forming shining black lines on the stems of the host with a delicate slit extending lengthwise through the center. On stems of *Scirpus* sp. I am indebted to Dr. J. F. Brenckle for specimens of this species.

New York Botanical Garden.

THE PERFECT STAGE OF THE COTTON ANTHRACNOSE

C. W. Edgerton

(With Plate 8, Containing Five Figures)

Perithecia of the genus *Glomerella,* the perfect stage of certain species of *Gloeosporium* and *Colletotrichum,* have been developed in most cases under artificial conditions, either in pure culture on artificial media or on old dead pieces of the host plant that have been kept in a moist condition. In only a few cases has the ascigeral stage been found developing naturally. The form from apple has been reported as occurring naturally, but even here the best development has been observed on artificial media or on diseased apples kept in a moist chamber.

While making a study of the cotton anthracnose, *Colletotrichum Gossypii,* in Louisiana during 1908, search was made at various times to discover whether the perithecial stage of this developed naturally on the cotton plant. Shear and Wood* have reported finding the perithecia in pure cultures, but their presence on the living cotton plant, or even on old dead parts of the plant, has never been reported. The anthracnose appears on all parts of the plant, cotyledons, leaves, stems and bolls, and search was made on all of these for the perfect stage. The conidial stage was especially abundant, and it is doubtful whether there was a single cotton plant in this section of the cotton belt that was not more or less affected with this stage, and, during the early part of the season, this stage alone was found.

However, on August 1, after a period of very warm and very wet weather, a single boll, picked while passing through a field at Baton Rouge, was examined in the laboratory and found to be covered with the perfect stage of the *Colletotrichum.* The boll was living, only about one half of it being covered with the

* Shear, C. L., and Wood, Anna K. Ascogenous Forms of *Gloeosporium* and *Colletotrichum.* Botanical Gazette 43: 259–266. 1907.

anthracnose, while the other half was perfectly green and healthy. Two days later, six bolls picked at random in different parts of the same field were examined, and three of them were found to contain perithecia. In only one case did the anthracnose cover the whole boll. On August 8, after a few days of comparatively dry weather, over a hundred bolls were brought in from the same field, but only two of these contained perithecia and they were small withered bolls. Again, on August 25, after another wet spell, fifty bolls were brought in from the same field and the perfect stage was found on four of these. In another field about a mile distant from the first one, bolls were also examined but with less success. Forty bolls picked August 4 showed no perithecia. However, toward the latter part of August, several bolls out of a considerable number were found to contain the perfect stage. From the conditions of temperature and humidity at the time, it seems possible that moisture and heat may be important factors in perithecial development in this species.

The study of the perithecia showed several interesting things. The perithecia were, as a rule, entirely embedded in the host tissue and only the more or less well-developed beaks extended through the epidermis of the boll. In only one instance (*pl. 8, f. 2*) were the perithecia observed on the surface of the boll. They were not collected together surrounding a nodule of fungus tissue as is commonly the case in this genus, but were more or less distinct and separate. Often they were so numerous that they crowded one another, but only rarely did they seem to have any connection with a common fungus stroma; often, also, the perithecia were entirely separate, each one being entirely surrounded by host tissue (*pl. 8, f. 3*).

A second interesting feature was the shape of the ascospores. *Glomerella* spores are generally more or less curved and elongate, while these were rarely curved and more elliptical (fig. 1, *a, b*). I have had the opportunity of studying spores from a number of different host plants, but I have seen in no other form, the short, thick, elliptical spores like those which occurred on the cotton. I have shown as a comparison, in fig. 1, *c*, ascospores that developed on the fig, *Ficus carica*. The perfect stage of this form has not hitherto been reported, but it does

not seem in any way distinct from the one on apple, *Glomerella fructigena* (Clinton) Sacc. Whether the shape of the ascospores of the cotton anthracnose was due to environment is a question. There is often considerable variation in the size of the ascospores from the same host as developed on different substrata, the spores developing on the host plant being as a rule smaller than those developing on nutrient media, but I have not noticed a varia-

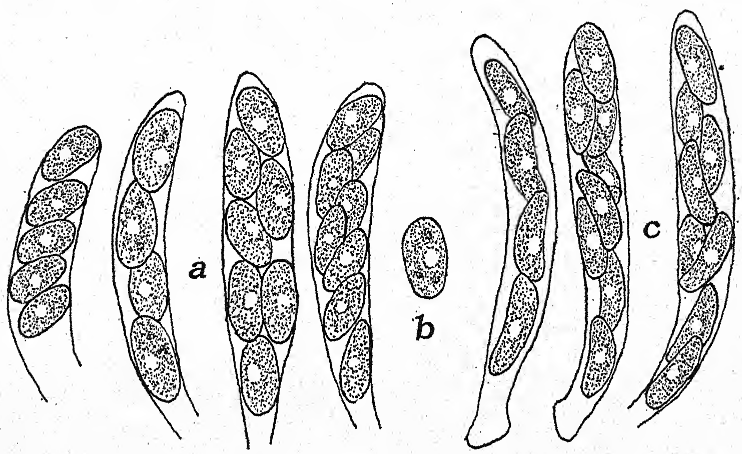


FIG. 1. Asci and ascospores of *Glomerella*. *a, Glomerella Gossypii*, asci and *ascospores; b*, same, typical ascospore; *c, Glomerella* from fruit of *Ficus carica*, showing asci and ascospores. All magnified 750 diameters.

tion in shape. As I have never seen ascospores of the cotton anthracnose that have developed on artificial media, I cannot compare them with those that developed naturally. But this difference in shape seems noteworthy and may represent a specific character.

A third feature, and the most interesting, developed from a study of the sterile threads which are now generally conceded to be present in all perithecia in this genus. The genus has been described at various times as (*a*) without paraphyses, (*b*) with paraphyses, and (*c*) with periphyses. These threads were so especially abundant in the perithecia from the cotton boll, that a good opportunity was offered for settling the point beyond a question. A large number of sections from 2 to 8 μ in thickness were made and studied. In many of the sections the sterile

threads were clearly seen, and their exact position in regard to the asci was shown. The presence of the threads between the asci was demonstrated with a certainty and can be clearly seen in the accompanying photomicrographs. While I have made scores of slides from other host plants, I was never before able to demonstrate their presence between the asci, and in a previous paper I expressed a doubt as to their occurrence in that position. The reason evidently lay in the better development of the threads in the perithecia from the cotton. These threads are much longer than the asci, extending to the ostiole of the perithecium, and entirely filling the cavity above the asci. If these sterile threads are to be called paraphyses, and there is little reason why they should not be called so, notwithstanding their length and irregularity, then the genus *Glomerella* must in the future be considered as paraphysate.

What effect this may have on retaining or discarding the generic name, *Glomerella,* cannot be told until some one has made a careful study of the various species of the genus *Physalospora.* Some of the perithecia of the cotton anthracnose fit perfectly the characters of the genus *Physalospora,* as shown in fig. 3, of the accompanying plate; however, others, as in fig. 2, do not. *Glomerella* perithecia, on artificial media or in a moist chamber, generally develop on the surface of the substratum and are not embedded in it, while *Physalospora* perithecia are not supposed to develop in this manner. But if it is found that members of this latter genus will develop on the surface of the substratum if the moisture conditions are suitable, then there are no generic characters separating the forms now resting in *Glomerella* and *Physalospora.* Several mycologists, such as Maublanc and Lasnier in France, and Sheldon in this country, are now calling the anthracnose forms *Physalospora;* but, until we know more of the development of these different forms, it seems best to keep them separate.

Although many of the anthracnoses found on different hosts are members of a single species, as has been shown by various investigators in the last few years, the evidence seems to show that some forms are distinct enough to represent different species. While morphologically the different forms are in many ways

similar, yet in some details there is considerable divergence in some of them. The form from cotton represents, perhaps, one of the most divergent types. I have studied this for some time and find no evidence for placing it in the same species with the organism causing the rot of various fruits. I have made many cultures at different times and from different places and find little variation in them. The characters which distinguish this from other forms may be briefly stated as follows: (1) A difference in color of the masses of spores, the cotton anthracnose spore-masses being more salmon than pink in color; (2) the abundance of setae; (3) the production of spores on the points of the setae; (4) the entirely distinct cultural characters; (5) the inability to inoculate satisfactorily other forms on cotton, or the cotton form on fruits, etc.; (6) the slight difference in the shape of the ascospores.

Consequently, believing that the evidence is sufficient to keep this form separate, I propose for it the following name and diagnosis:

Glomerella Gossypii sp. nov.

Perithecia distinct or crowded, very abundant, buried in the tissue of the host with only the beaks protruding, or rarely on the surface, dark brown to black, subglobose to pyriform, 80–120 × 100–160 μ, mostly about 115 × 140 μ. Beak of the perithecium sometimes 60 μ or more in length. Asci numerous, clavate, 55–70 × 10–14 μ, mostly 10–11 μ in thickness. Spores uniseriate or irregularly biseriate, nearly elliptical, or rarely slightly curved, granular, hyaline, showing a clear nucleus near the center, 12–20 × 5–8 μ, averaging 13–14 × 7 μ. Paraphyses long, slender, very abundant, filling the entire cavity of the perithecium above the asci.

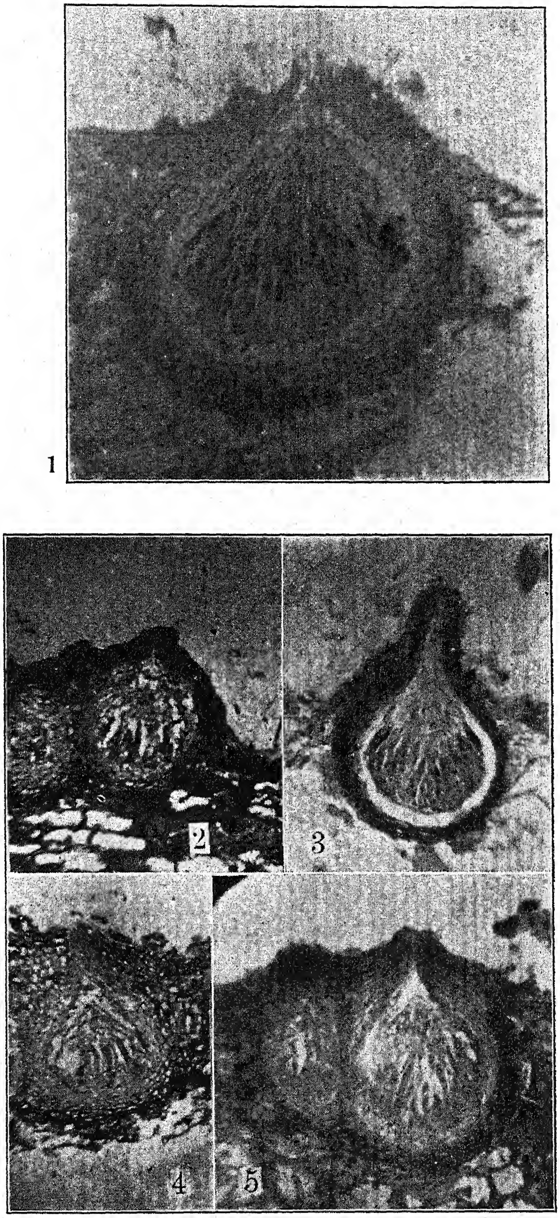
Perfect stage of *Colletotrichum Gossypii* Southworth, which preceded and accompanied it. Bolls of *Gossypium herbaceum,* August, 1908, Baton Rouge, La. Type material, with prepared sections, deposited in the United States National Herbarium, Washington, D. C.

LOUISIANA AGRICULTURAL EXPERIMENT STATION.

EXPLANATION OF PLATE VIII

FIGS. 1–5. *Glomerella Gossypii* sp. nov.

1. Perithecium showing the paraphyses, × 320.
2. Perithecium on surface of cotton boll, × 200.
3. Perithecium showing the beak that is commonly present, × 200.
4. An entirely imbedded perithecium, section 2 µ thick, showing three asci and the paraphyses between them, × 200.
5. Perithecium showing asci, paraphyses, and short beak, × 200.



GLOMERELLA GOSSYPII EDGERTON

ASCOMYCETES AND LOWER FUNGI—FASCICLE II

Guy West Wilson and Fred Jay Seaver

26. Albugo bliti (Biv.) Kuntze, Rev. Gen. Pl. **2**: 658. 1891

Uredo bliti Biv. Stirp. Rar. Sicilia **3**: 11. 1815.

On *Amaranthus retroflexus* L. Lapel, Ind., August 22, 1907. G. W. W.

27. Albugo bliti (Biv.) Kuntze

On *Amaranthus spinosus* L. Carmel, Ind., August 29, 1907. G. W. W.

28. Albugo Portulacae (DC.) Kuntze, Rev. Gen. Pl. **2**: 658. 1891

Uredo Portulacae DC. Fl. France **5**: 88. 1815.

On *Portulaca oleracea* L. Lapel, Ind., August 22, 1907. G. W. W.

29. Basidiophora Kellermanii (Ellis & Halsted) G. W. Wilson, Bull. Torrey Club **34**: 349. 1907

Peronospora Kellermanii Ellis & Halsted, *pro tem.;* Ellis & Everh. N. Am. Fungi *2201*. 1889. (hyponym.)

Plasmopora Kellermanii Swingle; Sacc. Syll. Fung. **9**: 342. 1891.

On leaves of *Iva xanthiifolia* (Fres.) Nutt.; Sykeston, N. Dak., summer, 1907. F. J. S.

While of a rather restricted range this species appears to be abundant in the territory which it infests, and is probably coextensive in range with its host.

30. Blitrydium fenestratum (Cooke & Peck) Sacc. Syll. Fung. **8**: 805. 1899

Patellaria fenestrata Cooke & Peck; Peck, Ann. Rep. N. Y. State Mus. **28**: 68. 1876.

Fargo, N. Dak., August, 1907. F. J. S.

This species is rather common in the above locality on dead twigs of *Populus tremuloides* Michx.

31. FUSICOCCUM CASTANEUM (Sacc.) Sacc. Syll. Fung. **3**: 249. 1884

Cytispora Castanea Sacc. Michelia **1**: 519. 1879.

On dead branches of *Castanea dentata* (Marsh.) Borkh., New York City, March, 1907. G. W. W.

This fungus was nowhere observed except on the immature twigs of a large branch which had been broken from a chestnut tree during a storm of the preceding summer.

32. GIBBERELLA PULICARIS (Fries) Sacc. Michelia **1**: 43. 1876

Sphaeria pulicaris Fries, Syst. Myc. **2**: 417. 1823.

On old stalks of *Zea Mays* L., Mount Pleasant, Iowa, summer, 1907. F. J. S.

33. HYPODERMA AQUILINA (Fries) Rehm, Ber. Naturh. Ver. Augsburg **26**: 68. 1881

Sphaeria aquilina Fries, Syst. Myc. **2**: 522. 1823.

On old leaf-stems of *Onoclea sensibilis* L., New York City, spring, 1907. F. J. S.

34. *Hypomyces Lactifluorum* (Schw.) Tul. Sel. Fung. Carp. **2**: 63. 1865

Sphaeria Lactifluorum Schw. Schr. Nat. Ges. Leipzig **1**: (30). 1822.

On some species of *Lactaria,* Fargo, N. Dak., summer, 1907. F. J. S.

Numerous specimens of the host were collected in woods near Fargo all of which were entirely parasitized by the fungus so that the gills were entirely eliminated.

35. HYPOMYCES POLYPORINUS Peck, Ann. Rep. State Mus. **26**: 84. 1874

On *Coriolus versicolor* (L.) Quel. = *Polyporus versicolor* (L.) Fries, Fargo, N. Dak., summer, 1907. F. J. S.

The present species was found in considerable quantity during

the past season on old sporophores of the host. The specimens have been compared with authentic material received from Professor Peck and conform well.

36. HYSTEROGRAPHIUM FRAXINI (Pers.) de Not. Disp. Pirenom. Ister. 22. 1847

Hysterium Fraxini Pers. Syn. Meth. Fung. 100. 1801.

On dead twigs of *Fraxinus*, Sykeston, N. Dak., July, 1907. F. J. S.

This fungus is very abundant on dead twigs of ash wherever the later occurs in considerable numbers.

37. MASSARIA INQUINANS (Tode) Fries, Summa Veg. Scand. 396. 1849

Sphaeria inquinans Tode, Fungi Meckl. **2**: 17. *pl. 10, f. 85.* 1791.

On *Viburnum dentatum* L., The Bronx, New York City, spring, 1907. F. J. S.

The perithecia are very large and buried with the ostiola extending through the bark. The spores spread over the surface of the bark and are so large that with the hand lens they appear as coarse shining granules. The species is distinguished by the large size of its spores.

38. MITRULA PHALLOIDES (Bull.) Chev. Fl. Paris **1**: 114. 1826

Clavaria phalloides Bull. Herb. France. *pl. 463. f. 3.* 1791.

On decaying leaves submerged in water in a swamp, New York City, spring, 1907. F. J. S.

39. MOLLISIA CINEREA (Batsch) Karst. Myc. Fenn. **1**: 189. 1871

Peziza cinerea Batsch, Elench. Fung. Cont. **1**: 197. 1786.

On herbaceous stems in swampy place, New York City, spring, 1907. F. J. S.

40. PERONOSPORA EFFUSA Rabenh. Herb. Myc. ed. I. 1880

On *Chenopodium album* L., Greencastle, Ind., August 3, 1907. G. W. W.

The bright yellow epiphyllous discolorations of this fungus were very conspicuous during the late summer in all patches of the host, not only here but in other sections of the state.

41. PHYLITAENA ARCUATA Berk. Grevillea **2**: 100. 1874

On dead stems of *Ambrosia trifida* L., The Bronx, New York City, March, 1907. G. W. W.

This species is rather common in the vicinity of New York on herbaceous stems, but is easily overlooked on account of the inconspicuous habit and the peculiar hypha-like spores which are $25–30 \times 1–2\,\mu$.

42. PHYLLACHORA GRAMINIS (Pers.) Fuckel, Symb. Myc. 216. 1869

Sphaeria graminis Pers. Syn. Meth. Fung. 30. 1801.

On leaves of *Elymus canadensis* L., Fargo., N. Dak., autumn, 1907. F. J. S.

43. PHYLLOSTICTA SMILACIS Ellis and Everh. Bull. Torrey Club **27**: 572. 1900

On *Smilax rotundifolia* L., The Bronx, New York City, September, 1906. G. W. W.

The synonymy of this species is very much involved and the fungus apparently very poorly understood.

44. PROPOLIS FAGINEA (Schrad.) Karst, Myc. Fenn. **1**: 244. 1871

Hysterium fagineum Schrad. Jour. Bot. **2**: 68. 1799.

On decaying wood, Fargo, N. Dak., August, 1907. F. J. S.

45. RHYSOTHECA HALSTEDII (Farl.) G. W. Wilson, Torrey Club **34**: 403. 1907

Peronospora Halstedii Farl.; Ellis, N. Am. Fungi *209*. 1879 (hyponym). Proc. Am. Acad. **18**: 72. 1883.

On leaves of *Bidens frondosa* L., Noblesville, Ind., August 24, 1907. G. W. W.

During the latter part of the summer it was almost impossible to find a plant of this host which was unaffected with the fungus.

46. SAPROLEGNIA FERAX (Gruith.) Nees, Nova Acta Acad. Leop. **11**[2]: 513. 1823

Conferva ferax Gruith. Nova Acta Acad. Leop. 1821.

On dead fish, New York City, spring, 1907. G. W. W.

This species is reported as common in the vicinity of New York City on fish of various species.

47. SPHAEROPSIS LINDERAE Peck, Ann. Rep. N. Y. State Mus. **39**: 45. 1896

On dead branches of *Benzoin Benzoin* (L.) Coulter, Westchester Co., N. Y., March, 1907. G. W. W.

The fungus infests the younger branches, which appear to have been killed by the mycelium of the fungus, while the sporangia develop saprophytically.

48. SPHAEROPSIS MENISPERMI Peck, Ann. Rep. N. Y. State Mus. **24**: 86. 1886

On recently dead vines of *Menispermum canadensis* L., First Mt., Orange, N. J., September 26, 1906. G. W. W.

This species, which is similar in habit to the preceding, was frequently observed in the vicinity of New York City.

49. SPHAEROPSIS SMILACIS Ellis & Everh. Jour. Myc. **5**: 149. 1899

On dead stems of *Smilax rotundifolia* L., The Bronx, New York City, March 22, 1907. G. W. W.

Not common and usually associated with other imperfect fungi.

50. TRICHOPEZIZA TILIAE (Peck) Sacc. Syll. Fung. **8**: 428. 1889

Peziza Tiliae Peck, Ann. Rep. N. Y. State Mus. **24**: 96. 1886.

Abundant on dead branches of *Tilia americana* L., Fargo, N. Dak., summer, 1907. F. J. S.

NEWS AND NOTES

Hedwigia for February, 1909, contains a biographical sketch, by Lindau, with portrait, of Paul Hennings, late curator of fungi at the Berlin Botanic Garden. The substance of this sketch, with the exception of the biblography, was reproduced in the Botanical Gazette for March.

Professor Hennings was born in a village in Holstein in 1841, and, after a short term at school, became an assistant in the botanic garden at Kiel under Nolte. He afterwards matriculated at Kiel and spent a few months there in study, but was in the main self-taught. In 1874, he began work on the cryptogams at Kiel as assistant to Eichler, and was called by Eichler to Berlin for this work in 1880. After a few years at Berlin, he devoted himself entirely to building up and studying the mycological collections, and, in 1902, was appointed royal professor. His published papers are numerous, those on tropical fungi alone probably numbering over two hundred.

For a number of years, Professor Hennings' health has been failing, and his arduous duties have allowed him scarcely any time for rest or recreation. The recent death of his son was a sad blow to him. Being sensitive and reserved in disposition and poetic in temperament, he felt deeply and keenly. He was often misjudged because of his retiring nature, but was exceedingly friendly and helpful to those seeking assistance in mycological work.

The Florida Agricultural Experiment Station Bulletin, No. 94, contains a summary of the "Fungus Diseases of Scale Insects and Whitefly," by H. S. Fawcett. The climate of Florida is especially suited to the combating of scale insect diseases by the use of their natural enemies, the fungi, and nowhere else in the world have these agencies been employed for that purpose to such as extent as in that state. The fungi which naturally grow on scale insects cannot grow on plants, so that their introduction for combating the scale insect cannot result in injury to the crops themselves.

Some of the fungi which have been employed in this work are the red-headed fungus, *Sphaerostilbe coccophila* Tul., the white-headed fungus, *Ophionectria coccicola* Ellis and Everh., the black fungus, *Myriangium Duriaei* Mont., the yellow fungus of the whitefly, *Aschersonia flavo-citrina* P. Henn., the red fungus of the whitefly, *Aschersonia Aleyrodis* Webber, and the brown fungus of whitefly, which bears no scientific name. The fungi here named have been known for years and used successfully, but, to ensure success, observations and treatment must be conducted with care. The material for use in connection with this kind of work is supplied by private parties.

A later publication by the same author on the subject of "Fungi Parasitic upon *Aleyrodes citri*" has been prepared as a thesis at the State University of Florida. This account records two other species of fungi, *Verticillium heterocladum* Penz., and *Microcera* sp., which are parasitic on *Aleyrodes citri* R. & H. and on scale insects.

In an article by J. Lagarde on "*Conditions biologoques et répartition des champignons dans le massif de l'Aigoual*" (Bull. Soc. Myc. de Fr. **24**: 197–220. 1909), the author deals with the difficult and interesting question of the distribution of the higher fungi as determined by the character of different localities, which are grouped as follows: (1) Cultivated valleys, (2) chestnut and oak woods, covering the lower mountain slopes, (3) coniferous woods, especially those planted in pine, (4) beech woods, on the higher slopes, (5) wet ravines, (6) pastures and other exposed places not under cultivation.

A list of species is given for each of these groups, and the habitats of many of the species are discussed. In the cultivated valleys are found, *Agaricus campestris, Panaeolus papilionaceus,* several species of *Coprinus, Schizophyllum alneum, Coriolus versicolor,* etc. A much longer list is given for the chestnut and oak woods, species of *Amanita, Lactarius, Russula, Boletus* and *Tricholoma* being prominent. *Amanita caesarea* is cited as being adapted, like the chestnut, to sandy soil, or soil free from lime, and conditions of moderate temperature and humidity. Wood-destroying species are discussed briefly.

In the coniferous woods, which have succeeded beech woods, the boleti predominate, especially *Boletus flavus* and *Boletus luteus,* which require resinous substances in the soil, and *Lactarius deliciosus* is also common. The beech forests furnish a large number of fungi. Among the larger forms, species of *Amanita, Russula* and *Clavaria* are conspicuous. *Amanita muscaria, Boletus edulis, Cantharellus cibarius* and *Hydnum repandum* are common. In wet ravines, certain species of discomycetes are found; also *Boletus scaber* and a few other moisture-loving species. In pastures, *Lepiota procera, Agaricus campestris,* species of *Lycoperdon,* and *Marasmius oreades* are the most important.

This is a very inviting field for the student of plant relations and one of great importance in connection with the study of associated higher plants. It requires, however, special training in mycology.

Mr. A. O. Garrett, of Salt Lake, Utah, has for several years been collecting and distributing the parasitic fungi of Utah. The following notes on the methods he has found most satisfactory in collecting rusts will doubtless be of assistance to others:

"In collecting the rusts, manila envelopes in which pamphlets, etc., have been received, are found to be very serviceable. When collecting, the affected leaves are piled up between the thumb and forefinger of the left hand; and when the pile becomes sufficiently large, it is transferred to the manila envelope. This is repeated until a sufficient quantity is gathered. The envelope not only prevents the spores of one species from becoming mixed with those of some other, but the leaves are kept in better shape for transferring to the press later. Of course, the envelope will not be used a second time; nor, for that matter, will the paper in which the specimens have been pressed. In these days of such diverse ideas in botanical naming, it becomes imperative that portions of the host-plant should be collected with the fungus, so that its identity may be preserved throughout the series of revisions that take place.

"In preparing the fungi for distribution, 'home-made' enve-

lopes are not only superior in quality, but also cost about one fourth as much as those obtained from dealers in botanical supplies. These envelopes should be made from a good quality of bond paper. This paper comes in three sizes: 17×22, 17×28, and 19×24 inches. The 17×22 size cuts into nine pieces, each $5\frac{2}{3} \times 7\frac{1}{3}$. This can be folded into an envelope approximately $2\frac{1}{2} \times 6$; or, folding the other way, $3\frac{1}{4} \times 4\frac{1}{2}$. Larger envelopes are sometimes needed, and these can be cut from the 19×24 sheet. Cutting three times each way, the resulting piece is $6\frac{1}{3} \times 8$ inches. This folds into an envelope either $3 \times 6\frac{3}{4}$ or $3\frac{3}{4} \times 5$ inches.

"Labels can be printed most cheaply by having the work done at some printing shop that makes label-printing a specialty. Here they will be printed at approximately a third of the price charged by the local printer. The labels are fastened to the envelopes by white glue made about as thick as thin cream."

The thirty-first annual report of the North Carolina Agricultural Experiment Station contains a descriptive list of more than fifty of the common plant diseases of that state, by F. L. Stevens and J. G. Hall, illustrated by ten plates.

A discussion by Mr. Fred J. Seaver of "Color Variation in Some of the Fungi" (Bull. Torrey Club 35: 307. 1908) calls attention to certain marked changes of color which occur in some species. The several illustrations, which are taken from the order Hypocreales, show the confusion resulting from the description of new species in this order, when based on color alone.

Under the title "Studies in North American Peronosporales—III" (Bull. Torrey Club 35: 361. 1908), several new and noteworthy species are listed by Professor G. W. Wilson. No. IV of the same series of papers (Bull. Torrey Club 35: 543. 1908) consists of a host index of the commonly recognized American species of the order.

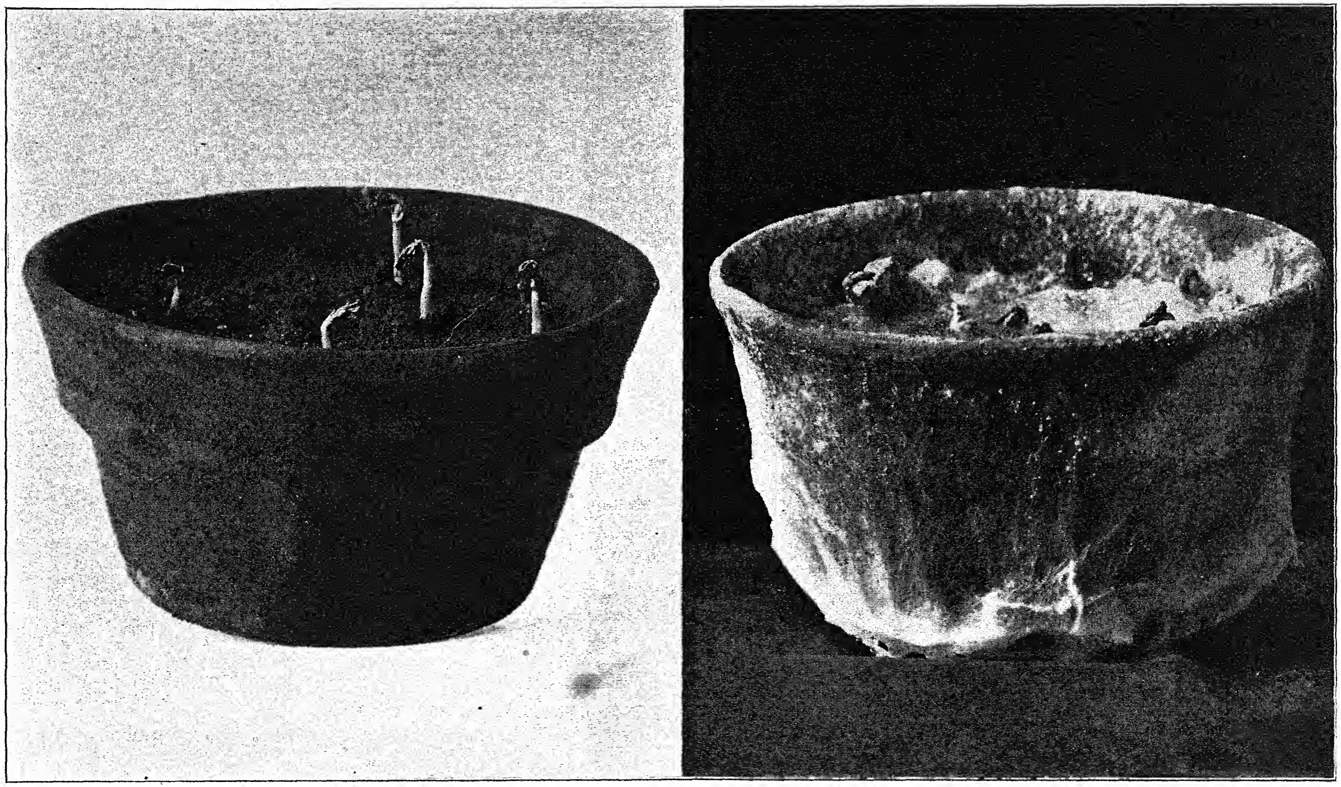
The Tenth Report of the Michigan Academy of Science contains a paper by C. H. Kauffman (**10**: 63–84. 1908) on unreported Michigan fungi for 1907, with an outline of the gasteromycetes of the state. This outline of the puff-balls and their relatives should be exceedingly helpful to students of this group anywhere in the northern United States.

Mycorhiza-producing basidiomycetes are discussed in a short paper by L. H. Pennington in the Tenth Report of the Michigan Academy of Science (**10**: 47–49. 1908). After a brief review of the work of others, the author describes the observations which led him to add *Boletus speciosus, Russula emetica, Tricholoma transmutans,* and an additional species of *Cortinarius* to the list of higher fungi that may produce mycorhiza upon the roots of certain species of oak.

Bulletin 144 of the Bureau of Plant Industry of the U. S. Dept. of Agriculture contains an article by W. M. Scott and J. B. Rorer devoted to the cause and treatment of the Apple Blotch, a disease which is very destructive to apples and is widely distributed over the eastern part of the United States. The disease is caused by *Phyllosticta solitaria* Ellis & Everh., and attacks the leaves, branches and fruit, but is most conspicuous on the branches and fruit.

The first appearance of the disease on the fruit is a very small light brown blotch. The blotch spreads until it attains often a diameter of one half an inch. The fungus destroys only the outer layers of cells and the continued growth of the tissues beneath causes a cracking of the diseased areas, the cracks often being one half an inch long. The disease mars the appearance of the fruit and unfits it for the market.

The experiments of the authors of the article have shown that the disease may be controlled by spraying with Bordeaux mixture. Full details as to the application of the remedy are contained in the bulletin named above.



SOIL CULTURES OF PYRONEMA OMPHALODES

MYCOLOGIA

VOL. I JULY, 1909 No. 4

STUDIES IN PYROPHILOUS FUNGI—I. THE OCCURRENCE AND CULTIVATION OF PYRONEMA

FRED J. SEAVER

(WITH PLATES 9–12, CONTAINING TWENTY-ONE FIGURES)

To the collector it is a well-known fact that there are numerous species of fungi which are known only on burnt places. While some of these forms may occur under other conditions, such occurrence is so rare as to have attracted comparatively little attention. Many popular reasons have been offered by individuals in explanation of these facts, such as the elimination of competition in the destruction of the higher plants, the presence of carbon in the soil, and that these forms really occur in other habitats and escape detection, but none of these reasons is sufficient to explain the occurrence of at least one of the plants in question. That these fungi do not occur on burnt places simply because the competition of the higher plants has been eliminated is shown by the fact that they do not, as a rule, occur on bare soil which has not been burned over. My own observation has also shown that carbonaceous materials are not necessary to the life of some of the pyrophilous fungi, and we must look for other explanations of these interesting phenomena.

The genus *Pyronema* includes several species, which, as the name implies, commonly inhabit burnt places. The occurrence of the plants of this genus on burnt ground is sufficiently common

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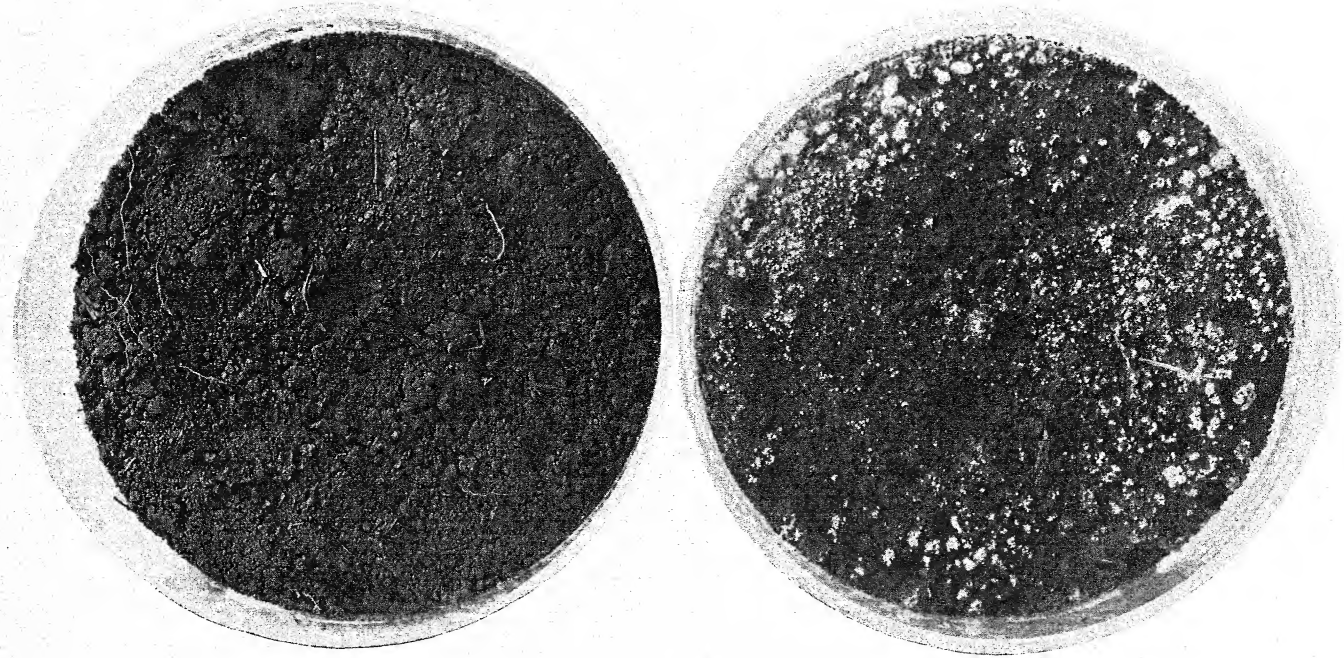
to have suggested the name of the genus, but no one has apparently considered the matter of sufficient importance to warrant investigation.* Since the most common species of the genus, *Pyronema omphalodes* (Bull.) Fuckel, is one of the few discomycetous fungi in which sexual reproduction has been demonstrated, numerous papers have been written on this phase of the subject, but in each case the matter of the occurrence of the species is dismissed with a simple statement of the fact. Nor, so far as known, has anyone taken the trouble to cultivate the species under artificial conditions either for the study of reproductive processes or in the attempt to gain information as to the reasons for its common occurrence on burnt ground.

The plants of this genus were first encountered by the writer in 1904, when the above-named species was found to be very common on burnt places near Iowa City, Iowa. Scarcely a burnt place could be visited in and about woods in wet weather on which this species was not found to be present and often in abundance, the plants appearing on charcoal and ashes and the burnt-over soil. While the individual plants are small, ranging from one to two millimeters in diameter, they commonly occur in dense confluent masses often covering a space of several inches, and by reason of their bright color they might, in spite of their small size, be counted among the more attractive forms of fungi.

The second occurrence of this species to attract the attention of the writer was during the fall of 1906 in the propagating houses of the New York Botanical Garden, where it was found to appear on soil sterilized with steam under a pressure of ten to fifteen pounds. Here the plants occurred as usual, forming rose-colored or salmon-colored sheets over the surface of the soil, the groups of plants being surrounded by a cobweb of mycelium. Under these conditions the plants seem to thrive for a time, but

* Since this paper went to press a synopsis of the article below has come to the attention of the writer showing that some of the conclusions drawn in the present paper have been previously arrived at. Although the present work was conducted without knowledge of this previous work and the line of experimentation is different, the conclusions, so far as the work has gone, are almost identical.

Kosaroff, P. Beitrag zur Biologie von *Pyronema confluens* Tul., gleichzeitig ein Beitrag zur Kenntniss der durch Sterilisation herbeigeführten Veränderungen des Bodens. Bot. Zeit. **66**: 23. 1908.



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finally mature their fruit and disappear. The species was said to occur on soil sterilized in this manner almost without exception and had been noted for several years past by those carrying on experimental work here requiring the sterilization of soils; but as the fungus usually appeared before seeds had germinated and apparently did no harm, it did little more than to arouse a passing interest. The attention of the writer was at length called to this fungus and it was identified as *Pyronema omphalodes* (Bull.) Fuckel. The occurrence of a fungus commonly associated with burnt places on soil sterilized with steam was a fact of unusual interest, since it indicated that charcoal and carbonaceous materials are not necessary to the life of this fungus as was previously supposed.

In trying to explain these facts it at once became apparent that the high temperatures to which the substrata had been subjected had something to do with the appearance of these plants under the above conditions, but whether the high temperatures had some relation to the spores of the fungus itself in stimulating them to germination or to the substrata only in preparing it for the growth of the fungus was at that time a question.

During the summer of 1907 the species was again observed in North Dakota, where it occurred on bare soil by roadsides where there was no trace of charcoal, but in places which it is easy to suspect had been fire-swept or subjected to considerable temperatures by the heat of the sun and natural conditions of sterilization.

The last appearance of these plants and the one which has prompted the study of the problem which has been made the basis of the present paper was in agar which had been inoculated with the spores of other fungi in the laboratories of the New York Botanical Garden. The appearance of this fungus, uninvited, in three different cultures at the same time in a laboratory where to my knowledge none of the plants of the genus had been studied, even from dried material, for more than two years was sufficiently mysterious to arouse interest.

There were two possible explanations of the appearance of this fungus at this time; one that the cultures had become inoculated with the spores from the air and the other that the spores were present in the cultures and had withstood the process of steriliza-

tion. That the spores might not only be able to withstand the process of sterilization, but might even be stimulated to germination by high temperatures was suggested, since it is claimed that the spores of some of the coprophilous fungi must be subjected to the body temperature and other influences of the alimentary canal of animals in order to induce their germination.

In order to test the matter of the effect of heat on the spores of the fungus, mature ascospores were heated to various temperatures and later planted in hanging drop cultures. The heating was accomplished both with dry heat and by heating in a drop of water. In no case could the spores which had been heated to any considerable temperature be made to germinate. On the other hand, mature ascospores which had not been heated germinated readily in drop cultures, proving that if high temperatures have anything to do with the appearance of this fungus the effect is on the substratum only, the spores themselves being as sensitive to heat as are those of other species of fungi.

This species is not sufficiently common to expect that the air of the laboratory is saturated with the spores at all times, but from later experiments it is evident that these cultures were inoculated from the air. The fact that the fungus occurred in cultures in which the agar had been poured over filter paper previously heated to 110° C. for purposes of sterilization again raised the question of the relation existing between this fungus and the heating of the substratum. Cultures of agar were later tried, leaving out the filter paper, and the fungus was found to grow fully as well as in the preceding case. The luxuriant growth of this species on agar is evidence that high temperatures are not necessary in all cases to its growth. Soils sterilized with dry heat require a higher temperature to bring about favorable conditions for the growth of this fungus than are necessary for the sterilization of agar.

From our own observations and experiments there is little doubt that this fungus occurs on burnt places as a result of sterilization of such places by fire. However, it is probable that sterilization means much more than the simple elimination of competition by the destruction of bacteria and other fungi present in the soil. The nature of the changes brought about in soil by heating

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to high temperatures is a question concerning which little is known and one which is of vital importance to the problem under consideration. While the heating of the soil destroys the fungi already present, there is every reason to believe that it prepares the way for the growth of those species which may be introduced subsequent to sterilization. The experimental work of the present paper has been based mainly on the one species, *Pyronema omphalodes* (Bull.) Fuckel, but the question of the effect of the heating of soils on the production of fungi is doubtless a large one and it is the intention of the writer to extend these investigations to other forms when fresh material can be secured for experimental work.

Some of the observations in support of the above conclusion are: in its occurrence on sterilized soil the fungus usually appears at a very early date and is mature before other forms of vegetation have had time to make any considerable growth; after maturing one crop of ascocarps the fungus gradually disappears, indicating that the most favorable time for its growth is immediately after sterilization; soil sterilized, moistened and allowed to stand for a week appears to be as unfavorable for the growth of *Pyronema* as soils which have never been sterilized, notwithstanding the fact that the soil is entirely free from other forms of vegetation so far as the eye can detect.

In its occurrence in nature on burnt ground, no notes have been made as to the relative time between the burning of the substratum and the appearance of the fungus. This would doubtless depend upon conditions of moisture. A place having been thoroughly sterilized would remain so until the return of moisture, when the *Pyronema* avails itself of the favorable conditions of sterilization and moisture and matures its crop of spores. So far as can be recalled, this species has been found on burnt places only when bare and apparently devoid of other forms of vegetation, indicating that it appears soon after burning or soon after the return of moisture to the burnt places.

In its occurrence on agar, the *Pyronema* grows rapidly, covering the surface of the agar in a three-inch petri dish in about four days. All of the cultures have been slightly contaminated with other fungi in the center of the dish, but fruit has not been

produced when the *Pyronema* has been planted in cultures already thoroughly contaminated with other fungi.

A fresh culture on agar in which the mycelium was radiating equally in all directions was contaminated by placing a drop of water rich in bacteria directly in front of the advancing mycelium. In a short time the water had evaporated, leaving only the contaminated spot. The mycelium continued to grow on both sides of the spot but refused to cross the infected area. Later, it gradually surrounded this area, which was apparently unfavorable to its growth.

In no case have I failed to produce an abundant crop of fruit in three to six days on soil sterilized under high steam pressure or with dry heat at a high temperature when such soils have been inoculated with the spores of the fungus. Indeed, such conditions are so favorable that it is difficult to prevent the fungus from invading such places even when not inoculated. On the other hand, in no case have I been able to produce more than a beginning of growth on unsterilized soil. Soils sterilized at low temperatures often produce a scant growth of ascocarps, which are, for the most part, devoid of the normal color.

The observation is made by Dr. R. A. Harper* that this plant also occurs on damp, well-rotted leaves where there has been no fire. I can account for this only on the ground that the leaves have been previously sun dried and subjected to natural conditions of sterilization, for in my experiments here every attempt to grow this fungus on unsterilized materials has failed. It is quite probable that other conditions of sterilization might give the same results as those produced by fire, but this point has not yet been demonstrated.

METHODS OF CULTIVATION FOR STUDY

The cultivation of fungi under artificial conditions is comparatively easy when we are able to meet the conditions in the laboratory under which they normally occur in nature. The apparent preference of this species for conditions of sterilization render it unusually favorable for cultivation under artificial conditions.

* Sexual Reproduction in *Pyronema confluens* and the Morphology of the Ascocarp. Ann. Bot. 14: 321. 1900.

The rapidity of growth, together with the fact that the sex organs in *Pyronema* are the largest known among the ascomycetes, should render the species of this genus of unusual interest to instructors who desire such material for study in the class-room, when the ease with which they may be artificially cultivated becomes known. The length of time during which the spores and mycelium will keep their vitality in the laboratory is a question which time alone will answer. When once the plant is started it can be cultivated generation after generation with perfect success, enabling the student to trace every step in the life-history of the plant from the germination of the spores to the production of the sex organs and, a few days later, the mature ascocarps.

The existence of sex organs in this plant has been known for many years, but it is only recently that Dr. R. A. Harper has demonstrated that these are actually functional. His study, however, was based on material collected under natural conditions, he having made no attempt to cultivate the species on nutrient media. The fact that this can be done would render the species as available for regular laboratory study as are the reproductive organs of some of the common algae.

If it is desired to study the reproductive organs from gross material, and agar is available, this is one of the best media to use, since the development of the plant can be studied in culture from day to day by placing it under the low power of a compound microscope. The surface of the agar is smooth and transparent, so that we may detect the earliest appearance of the forming fruit and these may be mounted on a slide in a drop of agar, thus eliminating grit and sand which might be present in material grown on soil. Much care must be taken to get the plants at a very early stage, for immediately after fertilization each cluster of sex organs is surrounded by the tissues of the developing ascocarp, which obscure the details of the reproductive organs.

Soil which has been heated to a high temperature is apparently more favorable for the production of the sex organs and ascocarps in large numbers than agar. In a pot of sterilized soil the fruit is produced on the pot as well as on the soil and can quite easily be removed for study. Since soil is always available and most nearly approaches the natural conditions for the growth of

the species, it is probably the most practical medium to be employed.

If plants are desired for sectioning, soft materials, such as broken leaves, may be placed on the soil and sterilized. In this case the fruit is formed in clusters on the leaves and soil. The pieces of leaves may then be removed, imbedded, and sectioned in the ordinary way, or the plants may be scraped off from the leaves and mounted and studied from the gross material.

SUMMARY

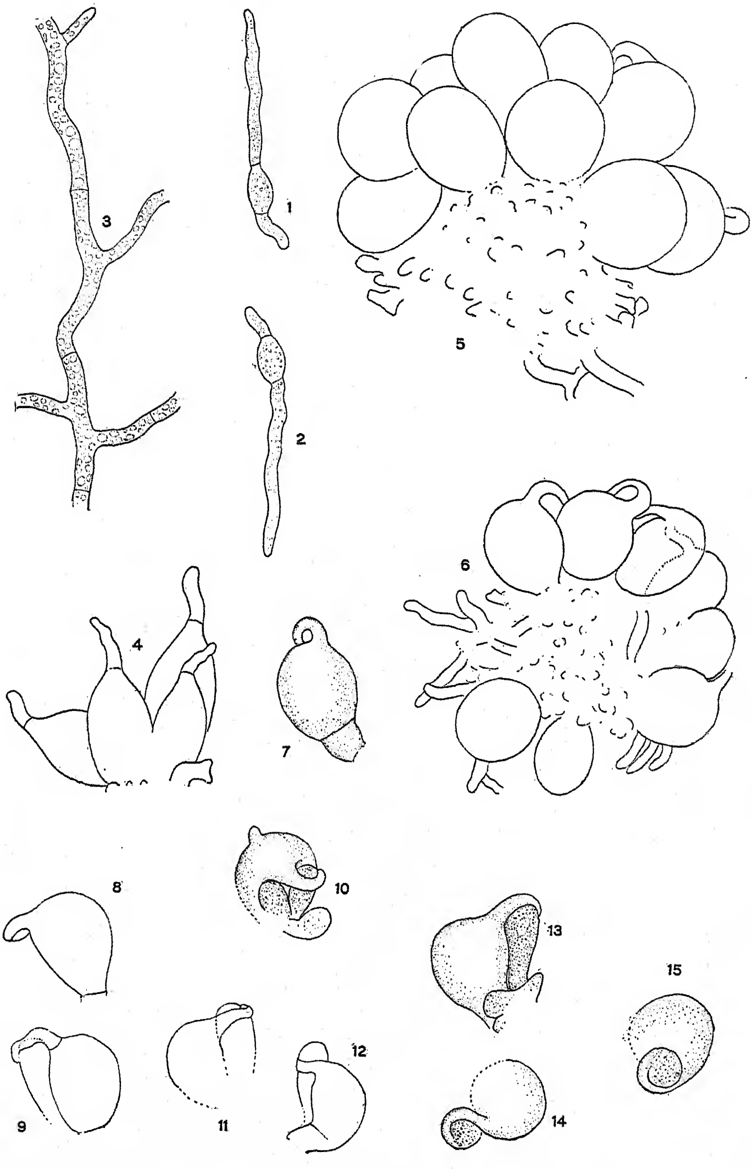
1. *Pyronema omphalodes,* which normally occurs on burnt places, can be successfully cultivated on nutrient media, producing sex organs on the fifth or sixth day and mature ascocarps in about ten days from the time of the planting of the spores.

2. This fungus will produce an abundance of fruit on soil or leaf-mold which has been sterilized by heating to high temperatures (110° C. or over), but refuses to produce fruit or any considerable mycelium on unsterilized soil or soil heated to low temperatures (less than 95° C.).

3. Sterilization by steam serves the same purpose as sterilization with dry heat, provided the soil is sterilized under sufficient pressure (5 lbs. or over). Soil sterilized under low pressure (2 lbs. or less) produces fruit only sparingly.

4. The time required to produce fruit on soil, as well as the abundance of the fruit itself, varies with the temperature to which the substratum has been subjected. Soil sterilized at 95° C. has produced no fruit; soil sterilized at 110° C. produces a fair quantity of fruit; while soil sterilized at 135°–145° C. produces fruit in abundance. The length of time of the application of the heat also has some influence.

5. Sterilization of soil by heat apparently brings about some change in the soil other than the simple elimination of competition in the destruction of bacteria and other fungi, which changes appear to be of vital importance in the cultivation of fungi which normally grow on burnt soil.



PYRONEMA OMPHALODES

EXPLANATION OF PLATES

PLATE IX

Two pots of soil, the left unsterilized, the right sterilized with dry heat at 140° C. for 15 hrs. Both were planted with seeds of pea, the sterilized pot soon becoming thoroughly infected with *Pyronema omphalodes* (Bull.) Fuckel, the unsterilized pot remaining uninfected. $\times \frac{3}{8}$.

PLATE X

Soil cultures, the left unsterilized, the right sterilized with steam under a pressure of 5 lbs. for 1–2 hrs. Both were innoculated with the spores of *Pyronema omphalodes* at a point near the center of the culture. The unsterilized culture produced no fruit and a very scant growth of mycelium surrounding the point of inoculation. The sterilized culture produced an abundant growth of mycelium and abundant fruit. $\times \frac{1}{2}$.

PLATE XI

Soil cultures, the left sterilized with dry heat at 110° C. for 1 hr., the right sterilized at 145° C. for 1 hr., the latter producing mycelium and fruit in much greater abundance than the former. $\times \frac{1}{2}$.

PLATE XII

1–2. Germination of spores of *Pyronema omphalodes* in hanging culture after 20 hrs.

3. Portion of mycelium drawn from culture grown on agar.

4. Portion of a cluster of oogonia at an early stage.

5. Cluster of oogonia drawn from material grown on agar.

6. Cluster of oogonia partially teased out.

7–13. Figures of oogonia and antherida drawn from material grown on agar.

14–15. End views of oogonia and antheridia drawn from culture material.

All the figures on this plate were sketched with the aid of a camera lucida, and are magnified 500 diameters.

NEW YORK BOTANICAL GARDEN.

THE BOLETACEAE OF NORTH AMERICA—II

William A. Murrill

Most of the genera of the Boletaceae were treated in the first part of this article, which appeared in the January number of Mycologia. The remaining genus includes a comparatively large number of species, many of which are rather difficult to distinguish. Owing to the perishable nature of these plants, there are also many doubtful species. For other recent papers on this group, the student is referred to Torreya 8: 50–55, 197–200, 209–217. 1908, and to the Bulletin of the Torrey Club 35: 517–526. *pl. 36–40.* 1908. The last two articles, on "Boleti from Western North Carolina" and "The Boleti of the Frost Herbarium," were reprinted as Garden Contributions 111 and 114.

11. Ceriomyces Battar. Fung. Hist. 62. *pl. 29.* 1755.
Not *Ceriomyces* Corda. 1837

Leccinum S. F. Gray, Nat. Arr. Brit. Pl. 1: 646. 1821. (Type species, *Boletus aurantiacus* Bull.)

Tubiporus Karst. Rev. Myc. 3⁹: 16. 1881. (Type species, *Tubiporus edulis* (Bull.) Karst.)

Krombholzia Karst. Rev. Myc. 3⁹: 17. 1881. Not *Krombholzia* Rupr. 1842. (Type species, *Krombholzia versipellis* (Fr.) Karst.)

Versipellis Quél. Ench. Fung. 157. 1886. (Type species, *Versipellis variegata* (Sw.) Quél.)

Ixocomus Quél. Myc. Fl. Fr. 411. 1888. (Type species, *Ixocomus badius* (Fr.) Quél.)

Xerocomus Quél. Myc. Fl. Fr. 417. 1888. (Type species, *Xerocomus impolitus* (Fr.) Quél.)

Hymenophore annual, terrestrial, centrally stipitate; surface dry, rarely viscid, glabrous or variously ornamented: context usually white or yellow, sometimes tinged with certain other colors, very rarely poisonous; tubes free or adnate, small, cylindrical, sometimes large and angular near the stipe: spores oblong-

ellipsoid, smooth, ochraceous to yellowish-brown: stipe solid, except in one or two species, even or reticulated, exannulate.

Type species, *Ceriomyces crassus* Battar.

Stem shaggy and lacerated, with reticulated furrows.
- Pileus dry, tomentose or reddish-pilose. 1. *C. Russellii.*
- Pileus viscid, glabrous. 2. *C. Betula.*

Stem smooth or reticulated with veins.
- Tubes white, not stuffed when young and not turning blue when wounded, colored at maturity with the yellowish-brown spores; pileus glabrous. A few subtomentose species have whitish tubes when young.
  - Stem smooth, pileus white, smooth. 3. *C. albellus.*
  - Stem reticulated.
    - Pileus white, with deep chinks forming areolae. 4. *C. frustulosus.*
    - Pileus gray, smooth. 5. *C. griseus.*
  - Stem scabrous, pileus smooth, rarely white.
    - Stem conspicuously bright yellow near the base. 6. *C. chromapes.*
    - Stem entirely white or grayish-white. 7. *C. scaber.*
- Tubes flesh-colored; cap small, floccose or squamulose.
  - Pileus adorned with appressed yellowish flocci; spores $14-16 \times 5-6\ \mu$. 8. *C. conicus.*
  - Pileus adorned with conspicuous dark purple scales; spores $9-12 \times 2-3\ \mu$. 9. *C. Vanderbiltianus.*
- Tubes bright yellow, sometimes tinged with scarlet, unchanging at maturity or in dried specimens.
  - Stem smooth, pileus glabrous.
    - Stem 2 cm. thick; spores $15 \times 6\ \mu$. 10. *C. flaviporus.*
    - Stem less than 1 cm. thick; spores $10 \times 4\ \mu$. 11. *C. auriporus.*
  - Stem reticulated, pileus and stem covered with a bright yellow or scarlet tomentum or pulverulence. 12. *C. auriflammeus.*
- Tubes some shade of yellow or brown, usually becoming darker with age. In *C. fumosipes*, *C. sordidus*, and *C. Roxanae*, the tubes are whitish when young.
  - Parasitic on species of *Scleroderma*. 13. *C. parasiticus.*
  - Found in clusters on roots and stumps of pine; pileus bright golden-yellow. 14. *C. hemichrysus.*
  - Found on the ground, rarely on wood much decayed and then not in clusters.
    - Tubes stuffed when young, their mouths usually white; pileus usually glabrous.

Stem furfuraceous, lilac-gray; pileus and tubes chocolate-brown. 15. *C. eximius.*

Stem smooth or reticulated; pileus and tubes of lighter color than above.

Spores brownish-ochraceous, 13–15 × 4–5 μ; stem more or less reticulated. 16. *C. crassus.*

Spores ferruginous-ochraceous, 9–12 × 4–5 μ; stem rarely reticulated at the top; pileus often olivaceous and spotted. 17. *C. affinis.*

Tubes not stuffed when young.

Pileus viscid, glabrous, small, yellow, sometimes more or less reddish-brown; stem not reticulated.

Tubes brick-colored, flesh peppery, stem solid, yellow at the base. 18. *C. piperatus.*

Tubes yellow, flesh mild.

Stem hollow, glabrous. 19. *C. Curtisii.*

Stem solid, dotted with yellow or red glandules. 20. *C. inflexus.*

Pileus glabrous or subtomentose, not viscid.

Stem reticulated, usually very distinctly so.

Pileus, tubes, and stem tawny-brown. 21. *C. tabacinus.*

Pileus yellow or brown, tubes yellow. 22. *C. retipes.*

Pileus red.

Stem bright lemon-yellow throughout; pileus without a bloom. 23. *C. speciosus.*

Stem red below, yellow above; pileus with a bloom. 24. *C. Peckii.*

Stem not reticulated, except in forms of *C. subtomentosus.*

Pileus glabrous.

Pileus red.

Stem yellow, sometimes with red stains; entire plant quickly changing to blue at any point

where touched. 25. *C. miniato-olivaceus.*

Stem red, yellow at the top; flesh and tubes slowly turning blue when wounded. 26. *C. bicolor.*

Pileus yellow or brown.

Tubes changing to blue when wounded; stem glabrous. 27. *C. pallidus.*

Tubes not changing to blue when wounded.

Stem furfuraceous, pale yellow; tubes pale yellow to greenish-yellow. 28. *C. subglabripes.*

Stem rough with minute, stiff, black hairs; tubes brown to black. 29. *C. scabripes.*

Pileus subtomentose; flesh usually spongy and drying readily.

Tubes not changing to blue when wounded.

Tubes whitish, becoming yellow; mouths small, circular. 30. *C. Roxanae.*

Tubes yellow; mouths large and angular, especially near the stem. 31. *C. subtomentosus.*

Tubes small, yellowish, becoming brick-red on drying or when bruised; pileus large, 9–13 cm. in diameter and 3 cm. thick. 32. *C. tomentipes.*

Tubes changing to blue when wounded.
Tubes at first grayish-white, discolored later by the spores; stem bluish-green at at top.
Pileus conspicuously reticulate-rimose. 33. *C. fumosipes.*
Pileus not reticulate-rimose. 34. *C. sordidus.*
Tubes yellow and large; stem and pileus usually red, the latter often cracked. 35. *C. communis.*

1. Ceriomyces Russellii (Frost)

Boletus Russellii Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 104. 1874.

Described from specimens collected in New England by Russell. This is a very handsome and well characterized species, closely allied to *C. Betula* but extending farther north in its range, being found in open deciduous woods from New England to Mississippi and west to Wisconsin.

2. Ceriomyces Betula (Schw.)

Boletus Betula Schw. Schr. Nat. Ges. Leipzig **1**: 90. 1822.
Boletus Morgani Peck, Bull. Torrey Club **10**: 73. *pl. 35.* 1883. (Type from Kentucky.)

Described originally from North Carolina and afterwards found several times in that state, as well as in Georgia, Alabama, Tennessee, Ohio and Kentucky. When Schweinitz moved to Pennsylvania, he doubtless confused *C. Russellii* with the plants he had collected in North Carolina. The two species are, however, quite

distinct, *C. Betula* having a smooth, perfectly glabrous, viscid, shining testaceous cap, while that of *C. Russellii* is dry and tomentose.

3. **Ceriomyces albellus** (Peck)

Boletus albellus Peck, Ann. Rep. N. Y. State Mus. 41: 77. 1888.

Described from Sandlake, New York, and also found in deciduous woods in Pennsylvania, District of Columbia, Virginia, West Virginia and Tennessee. The color of the cap, which is white or whitish, should at once distinguish it from nearly all other species of boleti.

4. **Ceriomyces frustulosus** (Peck)

Boletus frustulosus Peck, Bull. Torrey Club 24: 146. 1897

Described from specimens collected in open ground and on clay banks at Ocean Springs, Mississippi, and at Akron, Alabama, by L. M. Underwood. The deep chinks in the cap are very conspicuous in the type specimens. Young specimens recently collected in Mississippi by Mrs. Earle and in the District of Columbia by myself are doubtfully referred to this species, but they show the frustulose character very slightly.

5. **Ceriomyces griseus** (Frost)

Boletus griseus Frost; Peck, Ann. Rep. N. Y. State Mus. 29: 45. 1878.

? *Boletus flexuosipes* Peck, Bull. N. Y. State Mus. 2: 130. 1889. (Type from North Carolina.)

Described from specimens collected by Peck at Sandlake, New York. It occurs in open woods from New England to North Carolina, and is distinguished from *C. retipes*, to which it is very closely related, by its pure white tubes, those of *C. retipes* being decidedly yellow. The cap is gray and the stem usually whitish.

6. **Ceriomyces chromapes** (Frost)

Boletus chromapes Frost, Bull. Buffalo Soc. Nat. Hist. 2: 105. 1874.

A very attractive species, and one easily recognized by its stem, which is bright yellow near the base and finely scabrous over its entire surface. The cap is pale red and the tubes and most of

the stem white. Described from Vermont, and found commonly in open woods throughout eastern continental North America from Nova Scotia to Mississippi. I find also in the herbarium a handsome specimen of this plant mixed with certain of Baker's collections from Stanford University, California. S. Kawamura, in a recent number of the Botanical Magazine of Tokyo (**22**: (329). 1908), mentions this species as occurring in Japan, but I have not seen his specimens.

7. **Ceriomyces scaber** (Bull.)

Boletus scaber Bull. Herb. Fr. *pl. 132. f. 1.* 1782.
Boletus aurantiacus Bull. Herb. Fr. *pl. 236.* 1784.
Boletus niveus Fr. Obs. Myc. **1**: 111. 1815.
Leccinum aurantiacum S. F. Gray, Nat. Arr. Brit. Pl. **1**: 646. 1821.
Leccinum scabrum S. F. Gray, Nat. Arr. Brit. Pl. **1**: 647. 1821.
?*Boletus versipellis* Fries, Boleti 13. 1835.
Krombholzia scabra Karst. Rev. Myc. **3**[9]: 17. 1881.
Gyroporus scaber Quél. Ench. Fung. 162. 1886.

Described from France and common in various habitats, especially in and near woods, throughout Europe and North America. It is one of the best known and most abundant of all the boleti. The scabrous stem and the unchanging white flesh and tubes should distinguish it, in spite of the variable colors of the cap. *Boletus versipellis* of Fries (Boleti 13. 1835) seems only a variety with reddish cap and appendiculate margin.

8. **Ceriomyces conicus** (Rav.)

Boletus conicus Rav. Ann. Mag. Nat. Hist. **II. 12**: 430. 1853.

Known only from specimens collected by Ravenel in damp pine woods in South Carolina. The sporophore is small, having a conical cap adorned with appressed yellowish flocci, and the tubes are flesh-colored. I have examined the types at Harvard, and Dr. Farlow has kindly made for me an examination of their spores, which measure $14–16 \times 5–6\,\mu$.

9. **Ceriomyces Vanderbiltianus** (Murrill)

Boletus Vanderbiltianus Murrill, Torreya **8**: 215. 1908.

Described from specimens collected by the writer on the roadside in thin oak woods in Pink Bed Valley, North Carolina. The

cap is small, subconical, ornamented with conspicuous dark purple scales; the tubes are salmon-colored near the margin, becoming incarnate as the spores mature. On seeing the types of *C. conicus,* I realized at once that it was closely related to the present species, but Dr. Farlow has assured me, after a careful microscopic examination, that the difference in the size of the spores is alone sufficient to distinguish the species, those of *C. conicus* being considerably longer and about twice as broad.

10. **Ceriomyces flaviporus** (Earle)

Boletus flaviporus Earle, Bull. N. Y. Bot. Gard. **3**: 297. 1905.

Described from specimens collected by C. F. Baker at Stanford University, California. It differs from *C. auriporus* in being much larger, and in having larger spores. The general appearance of the two species is very similar.

11. **Ceriomyces auriporus** (Peck)

Boletus auriporus Peck, Ann. Rep. N. Y. State Mus. **23**: 133. 1872.

Boletus innixus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 103. 1874. (Type from Vermont.)

Boletus caespitosus Peck, Bull. Torrey Club **27**: 17. 1900. (Type from Virginia.)

This very attractive species, the tubes of which retain their golden-yellow color on drying, was originally described from North Elba, New York. It occurs in thin dry woods and on shaded roadsides throughout the eastern United States, from New England to Alabama. The cap is usually reddish-brown and the stem is viscid if the weather is not too dry.

12. **Ceriomyces auriflammeus** (Berk. & Curt.)

Boletus auriflammeus Berk. & Curt. Grevillea **1**: 36. 1872.

This species is of great interest, being very rare and very beautiful. It was originally collected in North Carolina by Rev. M. A. Curtis and sent by him to Berkeley, who described it. Peck found one plant at Sandlake, New York, and it was also reported by Beardslee from Brookside, West Virginia. A number of fine

specimens have recently been collected in North Carolina by Dr. House, Miss Burlingham and myself. The description given by Berkeley is both incomplete and inaccurate, but the bright golden-yellow color of the pileus and stem should easily distinguish it. The mouths of a few of the tubes sometimes appear scarlet, especially on drying, but this character is not at all conspicuous. The stem is beautifully reticulated.

13. **Ceriomyces parasiticus** (Bull.)

Boletus parasiticus Bull. Herb. Fr. *pl. 451. f. 1.* 1789.
Versipellis parasitica Quél. Ench. Fung. 159. 1886.
Xerocomus parasiticus Quél. Fl. Myc. 418. 1888.

Distinct from all other boleti in being parasitic. If separated from the *Scleroderma* on which it grows, it might be confused with *C. subtomentosus.* It has been found in several places in New York and New England, as well as in Europe and Asia.

14. **Ceriomyces hemichrysus** (Berk. & Curt.)

Boletus hemichrysus Berk. & Curt. Ann. Mag. Nat. Hist. **II. 12**: 429. 1853. Grevillea **1**: 35. 1872.

This very rare species was described from specimens collected by Ravenel in South Carolina on roots of *Pinus palustris.* It has since been collected in North Carolina, Alabama, New Jersey and New York, and always on roots or stumps of some species of pine. It is just possible that this is the plant found by McIlvaine in clusters on old stumps near Philadelphia and described by Peck as *Boletus fulvus.*

15. **Ceriomyces eximius** (Peck)

Boletus robustus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 104. 1874. Not *Boletus robustus* Fries. 1851.
Boletus eximius Peck, Jour. Mycol. **3**: 54. 1887.

Described from Brattleboro, Vermont, and found in thin woods and along roadsides from Nova Scotia to North Carolina and west to Pennsylvania and West Virginia. Its stem is very characteristic, being lilac-gray and furfuraceous, while the cap and tubes are chocolate-brown.

16. CERIOMYCES CRASSUS Battar. Fung. Hist. 62. *pl. 29.* 1775.

Agaricus bulbosus Schaeff. Fungi Bavar. **2**: *pl. 134.* 1763.
Boletus edulis Bull. Herb. Fr. *pl. 60.* 1781.
Boletus esculentus Pers. Obs. Myc. **1**: 23. 1794.
Leccinum edule S. F. Gray, Nat. Arr. Brit. Pl. **1**: 647. 1821.
Boletus separans Peck, Ann. Rep. N. Y. State Mus. **25**: 81. 1873. (Type from Greenbush, New York.)
Boletus decorus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 103. 1874. (Type from Brattleboro, Vermont.)
Boletus limatulus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 104. 1874. (Type from Brattleboro, Vermont.)
Boletus variipes Peck, Ann. Rep. N. Y. State Mus. **41**: 76. 1888. (Type from Menands, New York.)
Suillus bulbosus O. Kuntze, Revis. Gen. **3**: 535. 1893.
? *Boletus auripes* Peck, Ann. Rep. N. Y. State Mus. **50**: 107. 1898. (Type from Port Jefferson, New York.)
Boletus Atkinsoni Peck, Bull. N. Y. State Mus. **94**: 20. 1905. (Type from New York.)
Boletus nobilis Peck, Bull. N. Y. State Mus. **94**: 48. 1905. (Type from New York.)

This species is abundant, well known, and widely distributed in temperate regions, and, like most species of this character, it has many varieties and has received many names. The sporophore is large, with glabrous, brownish cap, white or yellowish flesh, stuffed tubes that soon change from white to yellowish or brownish, and a stout stem that is usually more or less reticulated, especially above. In Peck's variety *clavipes,* the stem is reticulated to the base, and in *B. separans* of Peck the stem, as well as the cap, is brownish-lilac in color. Most of the other American forms included in the above synonymy may be referred either to the type form or to one of the two varieties just mentioned.

17. **Ceriomyces affinis** (Peck)

Boletus affinis Peck, Ann. Rep. N. Y. State Mus. **25**: 81. 1873.
? *Boletus leprosus* Peck, Bull. N. Y. State Mus. **2**: 135. 1889. (Type from North Carolina.)
? *Boletus crassipes* Peck, Bull. Torrey Club **27**: 19. 1900. (Type from Mt. Gretna, Pennsylvania.)

Described from Greenbush, New York, and found rather commonly in thin woods from Vermont to North Carolina and west to Indiana. This species is not generally well known, but it is easily recognized after having been once carefully observed. The types of *B. leprosus* are destroyed and *B. crassipes* was described from notes and drawings only, so I have doubtfully referred them to the present species, although I have little doubt that they belong here.

18. **Ceriomyces piperatus** (Bull.)

Boletus piperatus Bull. Herb. Fr. *pl. 451. f. 2.* 1789.
Boletus ferruginatus Batsch. Elench. Fung. *f. 28.* 1783.
Leccinum piperatum S. F. Gray, Nat. Arr. Brit. Pl. **1**: 647. 1821.
Boletus Sistotrema Peck, Ann. Rep. N. Y. State Mus. **23**: 133. 1872.
Viscipellis piperata Quél. Ench. Fung. 157. 1886.
Ixocomus piperatus Quél. Fl. Myc. 414. 1888.

This species occurs throughout the northern United States and Europe in woods and open places near woods. It may be recognized by its rather small, yellow cap, acrid and peppery flesh, and brick-colored tubes.

19. **Ceriomyces Curtisii** (Berk.)

Boletus Curtisii Berk. Ann. Mag. Nat. Hist. **II. 12**: 429. 1853. Grevillea **1**: 35. 1872.
Boletus fistulosus Peck, Bull. Torrey Club **24**: 144. 1897. (Type from Auburn, Alabama.)

Described by Berkeley from specimens collected in pine woods in South Carolina by Curtis. Known to occur from North Carolina to Alabama and Mississippi. The yellow, viscid cap and slender, hollow stem should readily distinguish the species.

20. **Ceriomyces inflexus** (Peck)

Boletus inflexus Peck, Bull. Torrey Club **22**: 207. 1895.
? *Boletus rubropunctus* Peck, Ann. Rep. N. Y. State Mus. **50**: 109. 1898. (Type from Port Jefferson, New York.)

Described from specimens collected in open woods near Trexlertown, Pennsylvania, by Herbst. Difficult to distinguish from small forms of *C. scaber*, except by its yellow and smaller tubes.

21. **Ceriomyces tabacinus** (Peck)

Boletus tabacinus Peck, Bull. Torrey Club **23**: 418. 1896.

Known only from specimens collected in clay along roadsides in Alabama. Its tawny-brown cap and stem, the latter reticulated, and its peculiar habitat should distinguish the species.

22. **Ceriomyces retipes** (Berk. & Curt.)

Boletus retipes Berk. & Curt. Grevillea **1**: 36. 1872.

Boletus ornatipes Peck, Ann. Rep. N. Y. State Mus. **29**: 67. 1878. (Type from North Elba, New York.)

An attractive and well-marked species occurring commonly in thin woods from Nova Scotia to Alabama and west to Wisconsin. The cap varies in color from yellow to brown, the flesh and tubes are yellow, and the yellow stem is beautifully reticulated to the base. It was first described by Berkeley from plants collected by Curtis in North Carolina. Peck referred his first collections in New York to this species in 1872, but afterwards separated them under the name *B. ornatipes*.

23. **Ceriomyces speciosus** (Frost)

Boletus speciosus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 101. 1874.

Described from Brattleboro, Vermont, and found in thin deciduous woods from New England to North Carolina and Tennessee. It is a beautiful species, known by its apple-red cap, without bloom, and its brilliant yellow tubes and stem, the latter reticulated. *C. bicolor* and *C. Peckii* are closely related species.

24. **Ceriomyces Peckii** (Frost)

Boletus Peckii Frost, Peck, Ann. Rep. N. Y. State Mus. **29**: 45. 1878.

Boletus roseotinctus Peck, Bull. Torrey Club **27**: 612. 1900. (Type from North Carolina.)

This species occurs in rather open deciduous woods, especially along roads, and has been found from New England to North Carolina and west to Indiana. It was first described from specimens collected by Peck at Sandlake, New York. It is easily rec-

ognized by its red cap with a bloom like that of a peach. The tubes and upper part of the stem are yellow, the remainder of the stem red, and the whole stem, usually, reticulated. The stem of *C. speciosus* is entirely yellow and that of *C. bicolor* is not reticulated.

25. **Ceriomyces miniato-olivaceus** (Frost)

Boletus miniato-olivaceus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 101. 1874.

Boletus sensibilis Peck, Ann. Rep. N. Y. State Mus. **32**: 33. 1879. (Type from Gansevoort, New York.)

Boletus glabellus Peck, Ann. Rep. N. Y. State Mus. **41**: 76. 1888. (Type from Menands, New York.)

Described from Brattleboro, Vermont, from specimens collected by Frost in the borders of woods. Cap vermilion, soon fading, tubes bright yellow, stem yellow with pink markings. This species is easily distinguished among the red boleti by its quick change to blue at any point, either outside or inside, where bruised or even touched with the fingers. It occurs from Maine to North Carolina, and is said to be poisonous.

26. **Ceriomyces bicolor** (Peck)

Boletus bicolor Peck, Ann. Rep. N. Y. State Mus. **24**: 78. 1872.

Boletus rubeus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 102. 1874. (Type from Brattleboro, Vermont.)

Boletus squamulosus Ellis, Bull. Torrey Club **6**: 77. 1876. (Type from New Jersey.) Not *Boletus squamulosus* Rostk. *Boletus dichrous* Ellis, Bull. Torrey Club **6**: 109. 1876.

A beautiful species with smooth, purplish-red cap, bright yellow tubes, and smooth, red or yellow stem. When broken, both flesh and tubes change to blue. It occurs in open woods from New England to North Carolina and west to Ohio. It was originally described from Sandlake, New York, from specimens collected by Peck.

27. **Ceriomyces pallidus** (Frost)

Boletus pallidus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 105. 1874.

Described from Brattleboro, Vermont, and occurring in woods in the eastern United States from New England to Alabama. The cap and tubes are of a pallid color, the latter changing to blue when wounded.

28. **Ceriomyces subglabripes** (Peck)

Boletus flavipes Peck, Ann. Rep. N. Y. State Mus. 39: 42. 1887. Not *Boletus flavipes* Berk.
Boletus subglabripes Peck, Bull. N. Y. State Mus. 2: 112. 1889.
Boletus rugosiceps Peck, Bull. N. Y. State Mus. 94: 20. *pl. 20. f. 6–10.* 1905. (Type from Port Jefferson, New York.)

Described from Caroga, New York, but found also in woods in Nova Scotia, Maine, Connecticut and Missouri. It is rather difficult to recognize because of the variable color of its cap, which is usually some shade of red or brown.

29. **Ceriomyces scabripes** (Peck)

Boletus scabripes Peck; White, Bull. Torrey Club 29: 555. 1902.

Known only from specimens collected by Miss V. S. White at Bar Harbor, Maine, in 1901. The types and field notes are at the New York Botanical Garden. A large species with reddish-brown cap, brown, adnate tubes, and the stem ornamented with numerous small black points. On drying, it is said to exude a black juice with strong odor.

30. **Ceriomyces Roxanae** (Frost)

Boletus Roxanae Frost, Bull. Buffalo Soc. Nat. Hist. 2: 104. 1874.
? *Boletus multipunctus* Peck, Bull. N. Y. State Mus. 54: 952. 1902. (Type from Bolton, New York.)

Described from Brattleboro, Vermont, and known also from Maine, Connecticut, New York, Pennsylvania and North Carolina, growing in the edges of woods. The cap is yellowish-brown, with minute, floccose tufts, which partially disappear with age; while the margin is rather unusual in often curving or rolling upward on drying.

31. **Ceriomyces subtomentosus** (L.)

Boletus subtomentosus L., Sp. Pl. 1178. 1753.
Ceriomyces jujubinus procerus Battar. Fung. Hist. 64. 1755.
? *Boletus communis* Bull. Herb. Fr. *pl. 393B.* 1788.
Boletus crassipes Schaeff. Fungi Bavar. *pl. 112.* 1763.
Leccinum subtomentosum S. F. Gray, Nat. Arr. Brit. Pl. 1: 647. 1821.

Rostkovites subtomentosus Karst. Rev. Myc. 3[9]: 16. 1881.
Versipellis subtomentosus Quél. Ench. Fung. 158. 1886.
Xerocomus subtomentosus Quél. Fl. Myc. 418. 1888.
? *Boletus alutaceus* Morgan; Peck, Bull. N. Y. State Mus. **2**: 109. 1889. (Type from Kentucky.)
Boletus illudens Peck, Ann. Rep. N. Y. State Mus. **50**: 108. 1898. (Type from Port Jefferson, New York.)

This widespread species, of general distribution in deciduous woods throughout Europe and temperate North America, has many varieties and has been assigned many names, a number of which do not appear in the above synonymy. As in certain other species of boleti, the stem may be either entirely even or more or less reticulated, which has led to confusion. *Boletus illudens,* for example, is a variety with coarse reticulations which has received several names in Europe. This species is of a spongy texture and may be dried in the sun. The cap is usually yellowish-brown or olive-tinted, with a distinct tomentum, and the large tubes and stem are yellow. *C. communis,* a closely related species, usually has more red both in cap and stem.

32. **Ceriomyces tomentipes** (Earle)

Boletus tomentipes Earle, Bull. N. Y. Bot. Gard. **3**: 298. 1905.

This species suggests a gigantic *C. communis.* The tomentum on the cap and stem are peculiar, as is also the change in color of the tubes from yellow to brick-red. Described from specimens collected by C. F. Baker at Stanford University, California.

33. **Ceriomyces fumosipes** (Peck)

Boletus fumosipes Peck, Ann. Rep. N. Y. State Mus. **50**: 108. 1898.

Described from Port Jefferson, New York, from specimens collected by Peck in woods during July. It has since been found abundantly in the mountains of North Carolina both by Atkinson and myself, and I have also collected it at Falls Church, Virginia. The species is peculiar in having a pale bluish-green band at the top of the stipe. The cap is very reticulate-rimose, and the tubes are grayish-white, afterwards discolored by the deep ochraceous-brown spores.

34. **Ceriomyces sordidus** (Frost)

Boletus sordidus Frost, Bull. Buffalo Soc. Nat. Hist. **2**: 105. 1874.

Described from specimens collected by Frost on recent excavations in woods near Brattleboro, Vermont. Represented by four plants in the Frost herbarium, but rather difficult to connect with any specimens collected since. It has many characters in common with *C. fumosipes*, but is not reticulate-rimose. The cap is sordid, flesh white, tubes white, changing to bluish-green, and stem brownish, tinged with green above.

35. **Ceriomyces communis** (Bull.)

Boletus communis Bull. Herb. Fr. *pl. 393A, C.* 1788.
Boletus chrysenteron Bull. Herb. Fr. 328. 1791.
Versipellis chrysenteron Quél. Ench. Fung. 157. 1886.
Xerocomus chrysenteron Quél. Fl. Myc. 418. 1888.
Boletus fraternus Peck, Bull. Torrey Club **24**: 145. 1897. (Type from Auburn, Alabama.)
Boletus umbrosus Atk. Jour. Mycol. **8**: 112. 1902. (Type from Cayuga Lake, New York.)

This species is widely distributed and very common in woods and on mossy banks throughout the temperate regions of Europe and North America, and it has even been collected in certain parts of the Bahamas. As is the case with *C. subtomentosus*, a near relative, the sporophore is spongy-tomentose in texture and dries easily, although it is fleshy enough for food. The cap and stem are usually red, and the tubes yellow and large; the surface of the cap is soft, finely floccose, and often cracked. There are a number of varieties which are rather confusing at times.

DOUBTFUL SPECIES

Most of these might doubtless be referred to well-known species if we knew more about them.

Boletus badiceps Peck, Bull. Torrey Club **27**: 18. 1900. Described from notes and drawings made by McIlvaine from specimens collected in oak woods near Philadelphia, Pennsylvania. Types destroyed.

Boletus Bakeri Tracy & Earle, Pl. Baker. 1: 23. 1901. Described from specimens collected in moist aspen thickets in Colorado, at an elevation of 9000 ft. Too near *C. crassus* to be recognized as distinct without the discovery of better characters.

Boletus cubensis Berk. & Curt. Jour. Linn. Soc. **10**: 304. 1868. Known only from plants collected on the ground in Cuba by Wright. The types at Kew are pressed flat and show little except the squamulose, spotted character of the surface and the copious spores, which are oblong-ellipsoid, smooth, yellowish-brown, $17–21 \times 7\mu$. Although probably distinct, it is highly desirable to get additional information from fresh specimens before incorporating it into the genus. A *Ceriomyces cubensis* has already been published by Patouillard for a plant in a different group of fungi.

Boletus dictyocephalus Peck, Bull. N. Y. State Mus. **2**: 111. 1889. Described from notes and a single specimen collected by C. J. Curtis in North Carolina. Type not found.

Boletus eccentricus Peck, Bull. Torrey Club **27**: 18. 1900. Described from notes and drawings made by McIlvaine from specimens collected in grassy places in woods at Mt. Gretna, Pennsylvania. Types destroyed.

Boletus fulvus Peck, Bull. Torrey Club **27**: 19. 1900. Not *Boletus fulvus* Scop. Described from notes and drawings made by McIlvaine from twenty or thirty specimens collected on and about an old stump near Philadelphia, Pennsylvania. Types destroyed.

Boletus guadalupensis Pat. Bull. Soc. Fr. **16**: 177. 1900. Described from specimens collected by Duss in Guadeloupe. Types not seen.

Boletus ignoratus Banning; Peck, Ann. Rep. N. Y. State Mus. **44**: 73. 1891. Described from specimens collected near Baltimore,Maryland, by Miss M. E. Banning, who prepared a large manuscript volume, handsomely illustrated, on the fleshy fungi of Maryland, which she donated to the New York State Museum. Types not found.

Boletus leptocephalus Peck, Bull. Torrey Club **25**: 371. 1898. Not *Boletus leptocephalus* Jacquin. Described from specimens collected by Earle in dry pine woods in Alabama. Too near *C.*

crassus to be recognized as distinct without the discovery of better characters.

Boletus lignatilis Berk. & Curt. Jour. Linn. Soc. **10**: 303. 1868. Known only from Berkeley's very brief description drawn from specimens collected on rotten wood in dense woods in Cuba. The types at Kew add nothing to the description.

Boletus Morrisii Peck, Bull. Torrey Club **36**: 154. 1909. Described from specimens collected in sandy soil under scrub oaks at Ellis, Massachusetts. It is closely allied to *C. crassus,* but is said to be well marked by its dotted stem. I have not seen the types.

Boletus mutabilis Morg. Jour. Cincinnati Soc. Nat. Hist. **7**: 6. *pl. 1.* 1884. Not *Boletus mutabilis* of Batsch and others. Described from Ohio. Types not seen. Peck's New York plants of this name are either *C. sordidus* or *Tylopilus felleus.*

Boletus nebulosus Peck, Ann. Rep. N. Y. State Mus. **51**: 292. 1898. Described from mature specimens collected on shaded roadside banks near Raybrook, New York. It has points in common with *C. sordidus* and *Tylopilus felleus.*

Boletus Pocono Schw. Trans. Am. Phil. Soc. **4**: 154. 1832. Described from specimens collected in beech woods in the Pocono Mountains, Pennsylvania. Types destroyed and description inadequate.

Boletus radicosus Bundy, Geol. Wisconsin **1**: 398. 1883. Bundy's specimens are not in existence.

Boletus rimosellus Peck, Bull. N. Y. State Mus. **2**: 127. 1889. Described from notes and one dried specimen collected by C. J. Curtis in North Carolina. Type not found.

Boletus robustus Fries, Nov. Symb. **1**: 46. 1851. Described from specimens collected by Oersted in volcanic soil on the Irasi volcano, Costa Rica. The drawing made by Oersted represents an undeveloped specimen, which might be almost any species. The specimens preserved in spirit could not be found at Copenhagen.

Boletus rubinellus Peck, Ann. Rep. N. Y. State Mus. **32**: 33. 1879. Described from Gansevoort, New York. The description and the type plants indicate points in common with *C. communis* and *C. piperatus,* and it is desirable to study fresh specimens before deciding whether it should be kept distinct or referred to one of these species.

Boletus subpunctipes Peck, Bull. N. Y. State Mus. 116. Bot. 10: 19. 1907. Described from specimens collected in shaded, sandy soil near Menands, New York. Said to resemble *C. scaber* and *C. chromapes*.

Boletus subsanguineus Peck, Bull. Torrey Club 27: 17. 1900. Described from notes and drawings made by McIlvaine from specimens collected under beech trees near Philadelphia, Pennsylvania. Types destroyed. Specimens at Albany sent by Willcox from Washington, D. C., are *C. bicolor*.

Boletus tenuiculus Frost, Bull. Buffalo Soc. Nat. Hist. 2: 103. 1874. Described from Brattleboro, Vermont. The types are poor and the description brief.

Boletus unicolor Frost; Peck, Bull. N. Y. State Mus. 2: 100. 1889. Published by Peck from manuscript only. Frost's collection contains a single sheet with five poor specimens collected in pine woods and open sedgy places near Brattleboro, Vermont.

INDEX TO SPECIES

NEW YORK BOTANICAL GARDEN.

SPHAERODOTHIS, A NEW GENUS OF DOTHIDIACEOUS FUNGI

C. L. Shear

Sphaerodothis is the name proposed by Saccardo and Sydow in Sylloge Fungorum **16**: 625. 1902, for a subgenus of *Auerswaldia* to include the single species *Auerswaldia arengae* Rac. Par. Alg. and Pilze Java **3**: 27. 1900. The principal character used in separating this subgenus from the genus *Auerswaldia* of Saccardo was the shape of the spores which are spherical or subspherical. The genus *Auerswaldia* Sacc. is, however, untenable, being a homonym of *Auerswaldia* Rabenh., Hedwigia **1**: 116. *t. 15. f. 2.* 1857. Rabenhorst's genus was monotypic, being based on *Sphaeria lagenaria* Pers., which belongs to the earlier genus *Melanospora* Corda, Ic. Fung. **1**: 24. *t. 7. f. 297.* 1837. *Auerswaldia* Rabenh. and *Melanospora* Corda are, therefore, to be regarded as synonyms. Or if it should be maintained that *Sphaeria lagenaria,* the type of *Auerswaldia* Rabenh., is sufficiently different from the type of *Melanospora* to justify a separate genus, such a genus could hardly be made to include the species which Saccardo has referred to his *Auerswaldia,* as they have little in common with *Sphaeria lagenaria* except the continuous brown spores. *Auerswaldia lagenaria* (Pers.) Rabenh. is a hypocreaceous fungus, whereas *A. arengae* Rac. and most of the species included by Saccardo in his *Auerswaldia* are dothideaceous fungi. None of the species congeneric with *A. arengae* Rac. has a tenable generic name at present so far as we have been able to discover, unless some of the older names of pycnidial forms should prove to belong here. There is a possibility that *Lasmenia* of Spegazzini, published in Anal. Soc. Ci. Argent. **22**: 199. 1886, may have been based in part on an old specimen of one of these fungi in which the fugacious asci had disappeared and only the free ascospores remained.

The recent discovery of an apparently undescribed species, evidently congeneric with *Auerswaldia arengae* Rac., the type of the subgenus *Sphaerodothis* has led the writer, for want of a tenable

generic name for the new species, to raise *Sphaerodothis* to generic rank and to transfer to it some of the closely related species which seem to have, at present, no valid generic appellation.

Sphaerodothis gen. nov.

Sphaerodothis sub. gen. Sacc. & Syd., Syll. Fung. **16**: 625. 1902.

The type of the genus is *Auerswaldia Arengae* Rac., which was the monotype of the subgenus of Saccardo and Sydow *l. c.*

Sphaerodothis Neowashingtoniae sp. nov.

Stromata amphigenous, numerous, scattered, subelliptical in outline, irregularly depressed or somewhat collapsed, black, shining, minutely punctate under a lens, 3–8 mm. long, frequently seated on yellowish-brown spots; locules (ascogenous cells) numerous, small, ovate or oblong; ostioles few or wanting, umbilicate; asci fugacious, globose or subglobose, sessile or subsessile, 8-spored, 100–120 μ diam.; paraphyses apparently wanting; spores oblong-elliptic, smooth, somewhat flattened on one side and with a narrow oblong longitudinal depression in the middle, suggesting in appearance a date seed, hyaline at first and enveloped in a thick mucous layer which disappears at maturity when the spores become a deep chestnut brown, $56–68 \times 30–36\ \mu$. Free, mature spores frequently collapse, becoming saddle-shaped.

On leaves of *Neowashingtonia filamentosa,* National City, Cal., Jan. 7, 1907, C. O. Smith Coll. Type, No. 1572, C. L. Shear, in Herb. Dept. Agriculture.

This species appears to be readily distinguished from all others described by the large size and peculiar shape of its spores.

The following species belong to the same genus and should be transferred to it:

Sphaerodothis Chamaeropis (Cke.) comb. nov.

Auerswaldia Chamaeropis (Cke.) Sacc. Syll. Fung. **2**: 626. 1883.

Dothidea Champaeropsidis Cke. Grevillea **7**: 96. 1879.

Sphaerodothis palmicola (Speg.) comb. nov.

Auerswaldia palmicola Speg. Anal. Soc. Ci. Argent. **19**: 247. 1885.

Sphaerodothis rimosa (Speg.) comb. nov.

Auerswaldia rimosa Speg. Anal. Soc. Ci. Argent. **26**: 43. 1888.

Sphaerodothis densa (Bomm. & Rouss.) comb. nov.

Auerswaldia densa Bomm. & Rouss. Bull. Soc. Bot. Belg. **35**: 162. 1896.

Sphaerodothis Guilielmae (Henn.) comb. nov.

Auerswaldia Guilielmae Henn. Hedwigia Beibl. **39**: (78). 1900.

WASHINGTON, D. C.

POLYPORACEAE FROM JAPAN

William A. Murrill

The following interesting collection of Japanese polypores, seventy-one packets in all, was recently received for determination from Professors S. Kusano and S. Nohara, of the Agricultural College, Tokyo Imperial University. The Garden herbarium has formerly contained very little material in this group from Japan, and little has been known of the distribution of the species there, except through the published papers of Professor Hennings, of the Berlin Botanic Garden, who has reported the majority of the fifty or more species known to occur in Japan.

These specimens were collected in Tokyo (including Komaba), Iwaki, Shinano, Shimoosa, Kōnodai, Mt. Takao, Yoyogi, Nikko, Yumoto in Nikko, Oki Province, Formosa and Karafuto. The chief collectors were S. Kusano and S. Nohara, but the following names also appear: K. Miyake, Ch. Tanaka, K. Tanaka, T. Tanaka, Onuma, Yagi and Nakahara. The collector last mentioned obtained most of the specimens sent from Formosa and Karafuto.

Professors Kusano and Nohara are now planning to collect fungi in various parts of Japan on a larger scale, which seems highly desirable, as the mycological flora of Japan is apparently largely unknown at the present time.

Tribe POLYPOREAE

Bjerkandera adusta (Willd.) Karst. Medd. Soc. Faun. Fl. Fenn. **5**: 38. 1879.

Yoyogi, on dead trunk of *Celtis sinensis, Nohara, 48.* Tokyo, on some dead tree, *Kusano & Nohara, 70.*

Bjerkandera fumosa (Pers.) Karst. Medd. Soc. Faun. Fl. Fenn. **5**: 38. 1879.

Tokyo, on dead trunk of *Populus nigra pyramidalis, Kusano & Nohara, 20;* on *Populus nigra pyramidalis, Onuma, 65.*

Coltricia cinnamomea (Jacq.) Murrill, Bull. Torrey Club **31**: 343. 1904.

Tokyo, on the ground, *Nohara, 57.*

Coriolellus Kusanoi sp. nov.

Pileus small, dimidiate, sessile, laterally connate, broadly attached, slightly decurrent, 1.3–2 × 3–5 × 0.2–0.5 cm.; surface pale isabelline, sometimes brownish-discolored in places, glabrous, faintly zonate-sulcate; margin thin, acute, entire, concolorous, rigid, not inflexed on drying: context white, very thin, flexible; tubes concolorous within, about 3 mm. long behind, mouths slightly darker, angular, large, radially elongated, about 2 × 1 mm., edges somewhat thick, rigid, entire: spores hyaline; hyphae hyaline, 3–4 μ; cystidia none.

Type collected on dead *Cryptomeria japonica* at Sōma by S. Kusano, *51*. Also collected on the same host at Tokyo by S. Nohara, *54b*.

CORIOLOPSIS BADIA (Berk.) Murrill, Bull. Torrey Club **34**: 466. 1907.

Karafuto, *Nakahara, 53*.

CORIOLUS ABIETINUS (Dicks.) Quél. Ench. Fung. 175. 1886.

This species has been confused by some with *Polystictus pellucidus* Berk. (Challenger No. 263), described from specimens collected in Japan on slender stems of herbaceous plants. The description of this latter species much resembles that of *C. abietinus*, but the habitat as given is entirely impossible for it.

Mt. Takao, *T. Tanaka, 43*. Tokyo, on dead *Cryptomeria, Nohara, 45*.

CORIOLUS NIGROMARGINATUS (Schw.) Murrill, Bull. Torrey Club **32**: 649. 1906.

Tokyo, *Nohara, 69;* on *Prunus* sp., *Kusano & Nohara, 41;* on dead cherry tree, *Kusano, 41a*.

CORIOLUS PROLIFICANS (Fries) Murrill, N. Am. Flora **9**: 27. 1907.

Settsu, on a species of *Pinus, Ch. Tanaka, 62*.

CORIOLUS VERSICOLOR (L.) Quél. Ench. Fung. 175. 1886.

Iwaki, *Kusano, 24*. Tokyo, *Ch. Tanaka, 63a, 63b*.

EARLIELLA CORRUGATA (Pers.) Murrill, Bull. Torrey Club **34**: 468. 1907.

Formosa, on some tree, *Miyake, 22*.

FAVOLUS TENUIS (Hook.) Murrill, Bull. Torrey Club **32**: 100. 1905.

Formosa, *Nakahara, 21*.

HAPALOPILUS GILVUS (Schw.) Murrill, Bull. Torrey Club 31: 418. 1904. No. 10 is probably what Hennings has described as *Polyporus illicicola* (Engl. Bot. Jahrb. 32: 39. 1903). It differs from the ordinary forms of *H. gilvus* chiefly in its tomentose-asperate surface. No. 15a is an old resupinate specimen, with spores and cystidia corresponding to those of *H. gilvus.*

Tokyo, on dead *Cornus macrophyllus, Kusano & Nohara, 10;* on *Quercus* sp., *Kusano & Nohara, 50.* Nikko, on dead *Betula, Kusano & Nohara, 15a.*

INONOTUS RADIATUS (Sow.) Karst. Rev. Myc. 3^{9}: 19. 1881.

Tokyo, on living *Prunus, Ch. Tanaka, 60.*

Irpiciporus consors (Berk.) Murrill. *Irpex consors* Berk. Jour. Linn. Soc. Bot. 16: 51. 1878. Described from specimens collected at Kobi, Japan, on the Challenger expedition.

Tokyo, on dead stump of *Quercus, Nohara, 47.*

Irpiciporus japonicus sp. nov.

Pilei sessile, dimidiate, conchate, imbricate, united behind by mostly sterile tissue, 0.3–0.7 × 0.7–1 × 0.1–0.3 cm.; surface slightly zonate, glabrous, with silky luster, pale isabelline in dried specimens; margin thin, undulate, slightly inflexed on drying, ochraceous under a lens: context white, membranous; tubes large, irregular, angular, irpiciform at a very early stage, concolorous with the surface of the pileus, 1–3 to a mm., 3 mm. long behind, shorter in front, edges sharp, toothed: spores hyaline; hyphae hyaline, 3–4 μ; cystidia none.

Type collected on dead *Quercus* at Tokyo in October, 1908, by S. Kusano and S. Nohara, *28.*

IRPICIPORUS LACTEUS (Fries) Murrill, N. Am. Flora 9: 15. 1907.

Nikko, on a log of *Prunus* (?), *Kusano & Nohara, 2.*

Irpiciporus Noharae sp. nov.

Pileus semiresupinate, the resupinate portion nearly circular in outline, the reflexed portion dimidiate, thin, conchate, imbricate, 1–1.5 × 1.5–4 × 0.1–0.2 cm.; surface zonate-sulcate, hirsute-tomentose, avellanous-isabelline with pale fulvous markings; margin undulate, thin, concolorous, tomentose, inflexed on drying: context white, thin, flexible; tubes large and irregular, shallow, irpiciform at an early stage, white to slightly isabelline, 1–2 mm. long, 1–2 to a mm., edges sharp, irregular, crested and toothed: spores hyaline; hyphae hyaline; cystidia none.

Type collected on dead *Hibiscus syriacus* at Kōnodai, October, 1908, by S. Nohara, *49*.

Irpiciporus Tanakae sp. nov.

Pileus sessile, conchate, imbricate, decurrent behind, 1 × 1–2 × 1–0.3 cm.; surface pure white, glabrous, nearly smooth, azonate, opaque; margin thin, entire, concolorous, slightly striate, strongly inflexed on drying: context white, membranous; tubes large, irregular, more or less radially confluent, pale isabelline, 1–2 mm. in diameter, about 2 mm. long behind, the decurrent edges longer, the dissepiments irregularly toothed, acute: spores elongated, smooth, hyaline; hyphae hyaline, 2–3 μ; cystidia none.

Type collected on dead *Cryptomeria* on Mt. Takao by Ch. Tanaka, *54a*.

LAETIPORUS SPECIOSUS (Battar.) Murrill, Bull. Torrey Club **31**: 607. 1904.

Nikko, on *Tsuga* sp., *Kusano & Nohara, 6*.

PIPTOPORUS SUBEROSUS (L.) Murrill, Jour. Myc. 9: 94. 1903.

Nikko, Yumoto, on *Betula* sp., *Kusano, 27*.

POLYPORUS ARCULARIUS (Batsch.) Fries, Syst. Myc. **1**: 342. 1821.

Tokyo, on *Prunus* sp., *Kusano & Nohara, 46*.

POLYPORUS CELEBICUS P. Henn. Monsunia **1**: 12. *pl. 1. f. 5*. 1899.

Tokyo, on stump of *Quercus glandulifera*, *Kusano & Nohara, 1*.

POLYPORUS PERULA (Beauv.) Fr. Epicr. 437. 1838.

Formosa, on a root of some dead tree, *Nakahara, 7*.

PYCNOPORUS SANGUINEUS (L.) Murrill, Bull. Torrey Club **31**: 421. 1904.

Tokyo, on dead stem of *Prunus* sp., *Kusano & Nohara, 13*. Formosa, on *Pandanus* sp., *Nakahara, 19*.

TRAMETES DICKINSII Berk. Sacc. Sylloge Fung. 9: 196. 1891.

Collected by Dickins in Japan and named by Berkeley, but not published until the diagnosis was sent to Saccardo by Cooke. It must not be confused with *Polyporus Dickinsii* Berk. (Jour. Linn. Soc. Bot. **16**: 50. 1878), also from Japan, which is very different, being very thin and having large, shallow tubes. *Trametes nitida* Pat. (Jour. de Bot. 4: 17. 1890), described from Tonkin, is a resupinate form very much resembling *Tr. Dickinsii*.

Nikko, on dead *Quercus aliena*, *Kusano & Nohara, 3*. Oki Province, *Kusano & Nohara, 26*.

TRAMETES MÜLLERI Berk. Jour. Linn. Soc. Bot. **10**: 320. 1868.
Formosa?, *Nakahara?*, *36*.

Whitfordia musashiensis (P. Henn.). *Fomes musashiensis* P. Henn. Engl. Bot. Jahrb. **31**: 737. 1902.
Shibuya, near Tokyo, *Ch. Tanaka*, *59*.

Tribe FOMITEAE

ELFVINGIA FOMENTARIA (L.) Murrill, Bull. Torrey Club **30**: 298. 1903. Most of the specimens represent the form common in southern Europe.

Nikko, on dead *Betula* sp., *Kusano & Nohara*, *5*, *18*, *38*; on some dead tree, *Kusano & Nohara*, *15*. Karafuto, *Nakahara*, *31*, *34*.

ELFVINGIA LIPSIENSIS (Batsch) Murrill, Bull. Torrey Club **30**: 297. 1903. No. 29 is an indurated, almost resupinate form, having the young hymenium covered with a yellow layer, as sometimes occurs in *E. megaloma* and *E. tornata*.

Nikko, on dead *Betula* sp.?, *Kusano & Nohara*, *14*. Shimoosa, *Onuma*, *32*. Tokyo, *Kusano*, *52*; on *Ailanthus glandulosa*, *Onuma*, *30*. Shinano, on *Prunus* sp., *Yagi*, *29*.

ELFVINGIA TORNATA (Pers.) Murrill, Bull. Torrey Club **30**: 301. 1903.
Formosa, *Miyake*, *39*.

FOMES FRAXINEUS (Bull.) Cooke, Grevillea **14**: 21. 1885. This species is usually found on ash in Europe and America.

Tokyo, on a cherry tree, *Nohara*, *55*. Shinano, on *Prunus*, *K. Tanaka*, *11*. Locality not stated, *Kusano & Nohara*, *35*.

FOMES UNGULATUS (Schaeff.) Sacc. Syll. Fung. **6**: 167. 1888.
Locality not stated, *Nakahara*, *25*. Karafuto, *Nakahara*, *33*.

GANODERMA AMBOINENSE (Lam.) Pat. Bull. Soc. Myc. Fr. **5**: 70. 1889.
Nikko, on some dead tree, *Kusano & Nohara*, *8*.

GANODERMA FLABELLIFORME (Scop.) Murrill, Torreya **4**: 165. 1904. The specimen is old and the host is not given, thus leaving the determination somewhat in doubt.
Nikko, Yumoto, *Kusano*, *37*.

PYROPOLYPORUS FASTUOSUS (Lév.) Murrill, Bull. Torrey Club 34: 479. 1907.

Formosa, on dead tree, *Nakahara, 9.*

Tribe DAEDALEAE

CERRENA UNICOLOR (Bull.) Murrill, Jour. Myc. 9: 91. 1903.

Tokyo, on dead limbs of *Styrax Obassia, Kusano & Nohara, 4.*

CYCLOMYCES FUSCUS Fr. Linnaea 5: 512. *pl. 11. f. 3.* 1830. Japan is rather far north for this species.

Tokyo, on *Pasama cuspidata, Nohara, 67.*

Daedalea Kusanoi sp. nov.

Pileus sessile, dimidiate, applanate or slightly convex above, plane or convex below, somewhat imbricate, slightly decurrent, 3–4 × 5–6 × 1.5–2 cm.; surface very slightly sulcate, nearly glabrous, very pale isabelline; margin entire or undulate, acute, rigid, not inflexed on drying, concolorous: context white or nearly white, corky, homogeneous, 3–5 mm. thick; tubes labyrinthiform, pale isabelline, nearly 1 cm. long behind, the furrows 0.5–2 cm. long and 1–2 mm. broad, edges thick, obtuse, entire, somewhat uneven; spores subglobose to ovoid, smooth, hyaline; hyphae hyaline, 4–6 μ thick; cystidia none.

Type collected on a dead trunk in the Botanical Garden at Tokyo in 1901 by S. Kusano, *40, 64* (*duplicate*).

GLOEOPHYLLUM TRABEUM (Pers.) Murrill, N. Am. Flora 9: 129. 1908.

Tokyo, on dead *Cryptomeria japonica, Kusano & Nohara, 17;* on *Cryptomeria japonica,* half-burned log, *Nohara, 44.*

LENZITES BETULINA (L.) Fries, Epicr. Myc. 405. 1838.

Shinano, on stump of a dead willow, *K. Tanaka, 12.* Iwaki, *Kusano, 23.* Tokyo, on old rail, *Kusano & Nohara, 68.*

ADDITIONAL SPECIES REPORTED FROM JAPAN

The following list contains the principal pileate species of Polyporaceae reported from Japan, which are not included above. Since the determinations have not been verified except in a few cases, no attempt is here made to group the species in accordance with my own classification.

Irpex decurrens Berk., *Irpex Kusanoi* P. Henn. & Shir.; *Hyd-*

nofomes tsugicola P. Henn.; *Polyporus membranaceus* (Sw.) Fr., *Polyporus cinnabarinus* (Jacq.) Fr., *Polyporus pellucidus* Berk., *Polyporus ochrotinctus* Berk., *Polyporus vernicipes* Berk., *Polyporus Dickinsii* Berk., *Polyporus Pocas* Berk., *Polyporus Pocula* (Schw.) B. & C., *Polyporus officinalis* (Vill.) Fr., *Polyporus Schweinitzii* Fr., *Polyporus glaucotus* Cooke, *Polyporus illicicola* P. Henn., *Polyporus Shiraianus* P. Henn. (= *Pycnoporellus fibrillosus* (Karst.) Murrill), *Polyporus Shenoi* P. Henn.; *Polystictus Cryptomeriae* P. Henn., *Polystictus Ikenoi* P. Henn.; *Trametes styracicola* P. Henn.

Fomes fulvus (Fr.) Gill., *Fomes rimosus* (Berk.) Cooke, *Fomes igniarius* (L.) Gill., *Fomes Ribis* (Schum.) Gill., *Fomes volvatus* (Peck) Cooke, *Fomes concentricus* Cooke, *Fomes japonicus* (Fr.) Cooke; *Daedalea quercina* Pers., *Daedalea styracina* P. Henn. & Shir.; *Lenzites japonica* Berk., *Lenzites alutacea* Cooke, *Lenzites saepiaria* (Wulf.) Fr., *Lenzites variegata* Fr.

NEW YORK BOTANICAL GARDEN.

NEWS AND NOTES

Frequent requests are made for sample copies of the first numbers of MYCOLOGIA. We should be glad to receive duplicate copies of these numbers that are not in use.

The importance of the subject of pyrophilous fungi leads us to request those interested to make careful notes on all forms observed during the summer and autumn and to send them with the dried specimens to Mr. Seaver for critical examination.

We learn from *Science* that the Tennessee legislature has passed a bill giving twenty-five per cent. of the state's revenue for education, seven per cent. being for the university and experiment station.

Mr. Elam Bartholomew, editor and publisher of *Fungi Columbiani,* left his home in Stockton, Kansas, in June for a collecting trip of ten weeks on the Pacific Coast.

The mycological papers presented at the recent Baltimore meeting of the A. A. A. S. are reviewed in the number of *Science* issued June 4, 1909.

A valuable paper by F. A. Stockdale on the fungus diseases of cocoanuts in the West Indies appeared in the *West Indian Bulletin* 9: 361–381. 1909.

The Garden has recently received from Père Duss 113 packets

of fungi collected by him in Guadeloupe. Most of the fungi collected by Duss have been worked over by Dr. N. Patouillard, of Paris.

Professor F. L. Stevens, of the North Carolina Experiment Station, expects to visit the agricultural colleges and experiment stations of Europe during the summer.

Mr. J. R. Johnston, of the Bureau of Plant Industry at Washington, has recently been studying the bud-rot of the cocoanut in Cuba.

A paper by Freda M. Bachman on the Discomycetes in the Vicinity of Oxford, Ohio, is published in the proceedings of the Ohio State Academy of Science **5**: 19–70. 1909. The paper contains a description of more than sixty species occurring in that region, and is accompanied by four plates with sixty-two figures.

The Transactions of the Nova Scotia Institute of Science **12**: 165–205, 1909, contains a descriptive list of the Myxomycetes of Pictou County, by C. L. Moore. Four plates, illustrating the principal genera, accompany the text.

Part two of the Xylariaceae of Southern Brasil, by F. Thiessen, appeared in the April number of Annales Mycologici (**7**: 141–167. 1909). The paper is devoted mainly to the genus *Hypoxylon*, twenty-nine species and several varieties being listed, including one new species, *Hypoxylon verrucosum* Thiess. The subject of classification is discussed at some length.

The leaf-blight of the plane-tree (*Gloeosporium nervisequum*) became very noticeable on the Garden grounds during the first week in June, but the attacks of the fungus did not appear to be particularly injurious this season.

According to Mr. Perley Spaulding, of the U. S. Dept. of Agriculture, the white pine blight includes several distinct diseases: a leaf blight accompanied by *Septoria parasitica,* two leaf diseases caused by *Lophodermium brachysporum* and *Hypoderma lineare,* a leaf and twig blight caused by winter freezing, and a twig blight, probably caused by insects.

Mr. W. M. Scott, of the Bureau of Plant Industry, Washington, D. C., has been conducting experiments for the past two years in various states with lime-sulphur mixtures for the summer spraying of orchards. Circular 27, of that bureau, is a report of the second season's experiments on peach, apple and cherry orchards. The experiments resulted in certain modifications of the mixtures for the peach and the Japanese plum, but were very encouraging for further experiments and for widespread use in the orchard where Bordeaux mixture is found objectionable.

The Classification of the Basidiomycetes is discussed in a recent article by M. Léon Dufour (Rev. Gén. Bot. **20**: 417–429. 1908), in which he proposes for the higher Autobasidiomycetes three principal divisions: the Canthareliineae, including *Clavaria, Thelephora, Hydnum, Craterellus* and *Cantharellus;* the Polyporineae, ranging from *Polyporus* to *Fistulina,* and related to the preceding group by such genera as *Cyphella* and *Dictyolus;* and the Agaricineae, comprising *Boletus, Paxillus,* and a series of genera culminating in *Amanita.* The Polyporineae are characterized as a heterogeneous group which will probably have to be divided. In closing, the author states that the difficult problem of classifying the Basidiomycetes is just on the point of being solved.

The Boletaceae of North America will be published in monograph form at the close of the year. Specimens of these plants are desired from as many stations as possible. Species may be determined more or less accurately in the fresh condition by the use of the keys published in this number and in No. 1 of MYCOLOGIA. All specimens should be thoroughly dried by artificial heat, using a piece of wire netting suspended over a lamp or stove, or some other contrivance, and afterwards packed in boxes with naphthalene or moth balls.

The present season was somewhat earlier than usual for the larger fleshy fungi. *Coprinus micaceus* appeared April 15, and has been abundant since that time, after rains. A few plants of *Coprinus comatus* appeared about May 15 on a lawn where they grew late last fall, but these were probably exceptional, having passed the mild winter in the button stage. *Pleurotus sapidus* was fully grown and abundant on May 1. *Pluteus cervinus* occurred in great quantity on an old sawdust pile on May 15. Before the end of May *Clitocybe multiceps* appeared on a lawn where it grew last autumn, and has been abundant since. *Polyporus caudicinus* always matures early, so it was not surprising to find it in May; and the same is true of *Morchella*. A number of small fleshy forms appeared in fields and on roadsides during May and early June, but this is not unusual. A few plants of *Coprinus atramentarius* and *Hypholoma appendiculatum*, however, came as a surprise about May 15. On June 4, eighteen specimens of *Agaricus campestris* were collected in a field not far from Bronx Park.

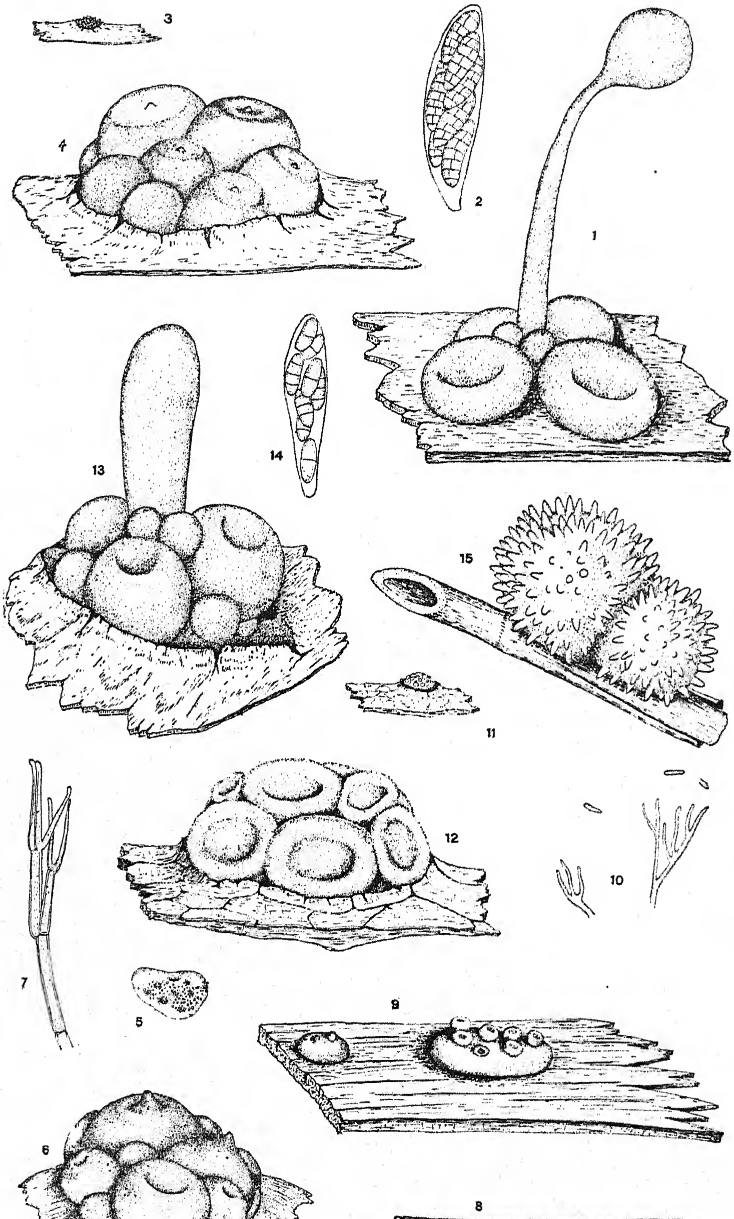
"The Association internationale des Botanistes founded, some years ago, an office where pure cultures of fungi can be obtained, either in exchange or on payment. The above-mentioned office proposes to compose a living register of the described fungi. Large numbers of species are mentioned in the handbooks which are said to be insufficiently described and which cannot possibly

be identified. The number of identical species, described under different names, is immense. This evil may be avoided in future if every mycologist, when describing a new fungus, sends a culture to the office of the Association. The author not only is relieved of the cultivation, but every one who is studying kindred species may procure material for comparison.

"Rather often applications are made to the office, but the collection does not grow in proportion to the description of new species. It has often occurred to us that on our requesting a person to send us a culture of a certain recently described fungus, the author was obliged to reply that as the work was passing through the press the cultures were lost. We beg you not to send the new species only but also those of which you have pure cultures and which are not mentioned on our list, published regularly in the 'Botanisches Centralblatt,' because many species are asked for which we do not possess. You are requested to tell us whether the species left to our care want frequent renewing. The greater part of our cultures are transferred but once every three months, but many of them want particular care.

"We beg to state again our terms, which are 3 florins (Dutch money) for non-members and 1.50 florins for the members of the Association."

(Signed) DR. JOHANNA WESTERDIGH,
Roemer Visscherstraat 1,
Amsterdam, Holland.



CREONECTRIEAE

MYCOLOGIA

Vol. I — September, 1909 — No. 5

THE HYPOCREALES OF NORTH AMERICA—II

Fred J. Seaver

(With Plate 13, Containing 15 Figures)

Tribe II. Creonectrieae

Conidial phase profuse, giving rise to a stroma producing at first conidiophores and conidia, later perithecia; stroma fleshy, depressed, tubercular or stalked, conidia variable; perithecia seated on or surrounding the stroma; usually in dense cespitose clusters or occasionally scattered but always entirely superficial; perithecia and spores as in Nectrieae.

Stroma upright, stalked, surrounded at the base by the cespitose perithecia.	
Spores 1-septate.	12. Sphaerostilbe.
Spores muriform.	13. Megalonectria.
Stroma depressed or tubercular, often concealed at maturity by the perithecia.	
Spores simple.	
Spores hyaline.	14. Allantonectria.
Spores brown.	15. Sphaerodermatella.
Spores compound.	
Spores 1-septate.	
Spores hyaline.	16. Creonectria.
Spores brown.	17. Macbridella.
Spores more than 1-septate.	
Perithecia dark blue (black to naked eye).	18. Gibberella.
Perithecia bright colored, red, yellow, etc.	
Perithecia cespitose on a depressed stroma.	19. Scoleconectria.

[Mycologia for July, 1909 (1: 131–176), was issued 22 July 1909.]

Perithecia echinulately arranged on a subglobose stroma.	20. ECHINODOTHIS.
Spores muriform.	
Spores hyaline.	21. THYRONECTRIA.
Spores brown.	22. THYRONECTROIDEA.

12. SPHAEROSTILBE Tul. Fung. Carp. **1**: 130 (in note). 1861

Stroma (*Stilbum, Atractium, Microcera*) consisting of a slender stalk with a subglobose head or conical in form; perithecia bright colored, membranaceous, globose, subglobose or ovate; asci cylindrical or subcylindrical, 8-spored; spores hyaline, 1-septate, elliptical or subelliptical.

Type species: *Stilbum aurantiacum* Babingt.

Stroma consisting of a slender stalk with a clavate or subglobose head.	
Spores small, 10–14 × 4–6 mic.	1. *S. gracilipes.*
Spores large, 22–26 × 7 mic.	2. *S. cinnabarina.*
Stroma conical in form.	
On bark.	3. *S. flammea.*
On scale insects.	4. *S. coccophila.*

1. SPHAEROSTILBE GRACILIPES Tul. Fung. Carp. **1**: 130. 1861

Strilbum gracilipes Tul. Ann. Sci. Nat. IV. **5**: 114. 1856.

Stilbum corynoides Ellis & Everh. Jour. Myc. **1**: 153. 1885.

Stroma consisting of a slender stalk 2–3 mm. high of a grayish color with a globose, orange head .5–1 mm. in diameter; conidia elliptical, hyaline, 5–6 × 2 mic.; perithecia in dense cespitose clusters 1–2 mm. in diameter at the base of the stalked stroma, 15–30 in each cluster, reddish, becoming pale (in dried specimens often pale yellow), 250–300 mic. in diameter, nearly globose, partially collapsing or entire, slightly roughened; asci cylindrical, 75–80 × 7–8 mic.; 8-spored; spores mostly 1-seriate, elliptical to subfusoid, hyaline, 1-septate, 10–14 × 6 mic., usually not constricted.

On bark of various trees and shrubs, *Carya, Citrus, Hibiscus, Platanus.*

TYPE LOCALITY: Europe.

DISTRIBUTION: S. Carolina to Florida and Louisiana.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 12, f. 1–4.*

EXSICCATI: Ellis & Everh. N. Am. Fungi, *2131, 2132;* Ravenel, Fungi Am. Exsicc. *285;* Other specimens examined: Florida, *Nash.*

2. SPHAEROSTILBE CINNABARINA (Mont.) Tul. Fung. Carp. 1: 130. 1861

Stilbum (*Atractium*) *cinnabarinum* Mont. Ann. Sci. Nat. II. 8: 360. 1837.

Stroma with a slender stalk 1–2 mm. long and a globose or clavate, red head; conidia nearly elliptical, straight or a little curved, 3–5 × 2 mic., granular within; perithecia few, surrounding the base of the stalked stroma, sessile, globose, smooth, orange, finally partially collapsed; asci clavate, about 80 × 13–16 mic.; spores 2-seriate, ovate, 22–26 × 7 mic., filled with numerous oil-drops.

On bark of trees and shrubs.

TYPE LOCALITY: Cuba.

DISTRIBUTION: S. Carolina to Mexico and Cuba.

EXSICCATI: Ellis & Everh. N. Am. Fungi *2133*. Other specimens examined: Cuba, *Wright;* Louisiana, *Langlois 168, 2179*.

The specimens examined did not show mature perithecia and measurements of asci and spores are from Saccardo. The conidial phase scarcely differs from *Sphaerostilbe gracilipes* Tul.

3. SPHAEROSTILBE FLAMMEA (Berk. & Rav.) Tul. Fung. Carp. 1: 130. 1861

Atractium flammeum Berk. & Rav.; Berk. & Broome, Ann. Mag. Nat. Hist. 13: 461. 1854.

Stilbum flammeum Tul. Ann. Sci. Nat. IV. 5: 114 (No. 757). 1856.

Stroma conical in form with the top finally becoming flattened; conidia fusiform, a little curved, 5–8-septate, about 60–75 × 5–7 mic.; perithecia nearly globose, bright red, smooth or only minutely rough, crowded on or near the base of the stroma; asci cylindrical, about 75–80 × 8–10 mic., 8-spored; spores 1-septate, elliptical to subfusoid, 1-septate, hyaline, 15 × 6–7 mic.

On bark of trees, *Acer, Crataegus, Salix*.

TYPE LOCALITY: Europe.

DISTRIBUTION: Ontario to Louisiana and S. Carolina.

ILLUSTRATIONS: Tul. Fung. Carp. 3: *pl. 13, f. 10–13*.

EXSICCATI: Ellis & Everh. N. Am. Fungi, *3311*. Other specimens examined: Louisiana, *Langlois 2290;* N. Jersey, *Ellis;* Ontario, Canada, *Dearness*.

4. SPHAEROSTILBE COCCOPHILA (Desm.) Tul. Fung. Carp. 3: 105. 1865

Microcera coccophila Desm. Ann. Sci. Nat. III. **10**: 359. 1848.

? *Nectria aurantiicola* Berk. & Br. Jour. Linn. Soc. **14**: 117. 1875.

? *Nectria aglaeothele* Berk. & Curtis, Grevillea 4: 45. 1875.

Nectria subcoccinea Sacc. & Ellis, Michelia **2**: 570. 1882.

Stroma consisting of a short, stout stalk with an orange head; conidia straight or more often curved, long, fusiform, 3–7-septate, 50–90 × 5–6 mic., occasionally shorter; perithecia more or less cespitose, bright orange, with a prominent, rather acute ostiolum; asci cylindrical, 75 × 8–10 mic., 8-spored; spores 1-seriate, elliptical or subelliptical, 12–18 × 7–9 mic.

On dead scale insects on bark, etc.

TYPE LOCALITY: France.

DISTRIBUTION: Florida to Alabama, Pennsylvania and the West Indies.

ILLUSTRATIONS: Fawcett, Bull. Fl. Agric. Exp. Sta. **94**: *f. 2–3*.

EXSICCATI: Ellis, N. Am. Fungi, *1333;* Ravenel, Fungi Car. Exsicc. *57*. Other specimens examined: Florida, *Hume 39*.

The exsiccati cited are distributed under other names but both show the characteristic conidia and perithecia of the above species. Also both occur on scale insects.

13. MEGALONECTRIA Speg. An. Soc. Ci. Argent. **12**: 82. 1881

Stroma consisting of a slender stalk with a globose head; perithecia globose or subglobose, bright colored, red or reddish, entire or collapsing, borne in cespitose clusters on or surrounding the base of the stroma; asci clavate, 8-spored; spores elliptical, many-septate, becoming muriform, hyaline.

Type species: *Sphaeria pseudotrichia* Schw.

Distinguished from *Sphaerostilbe* by the muriform spores.

1. MEGALONECTRIA PSEUDOTRICHIA (Schw.) Speg. An. Soc. Ci. Argent. **12**: 82. 1881

Sphaeria pseudotrichia Schw.; Berk. & Curtis, Jour. Acad. Nat. Sci. Phil. II. **2**: 289. 1853.

Nectria pseudotrichia Berk. & Curt. Jour. Acad. Nat. Sci. Phil. II. **2**: 289. 1853.

Sphaerostible pseudotrichia Berk. & Broome, Jour. Linn. Soc. **14**: 114. 1875.

Stroma consisting of a slender stalk with a subglobose, reddish head; conidia 3–5 × 2 mic., hyaline; perithecia nearly globose, subcespitose, usually in or surrounding the base of the stroma, red, minutely rough, finally collapsing; asci clavate, very broad, 8-spored, 60–75 × 20–22 mic.; spores 2-seriate or irregularly crowded, large, 7–9-septate and muriform, yellowish-hyaline, 25–35 × 7–8 mic. (*pl. 13, f. 1–2*).

On bark, wood, etc.

TYPE LOCALITY: Surinam, S. America.

DISTRIBUTION: West Indies.

ILLUSTRATIONS: Berk. & Curtis, Jour. Acad. Nat. Sci. Phil. **2**: *pl. 25, f. 9*.

SPECIMENS EXAMINED: Cuba, *Murrill 156;* Jamaica, *Cockerell 37;* Porto Rico, *Heller 773, 775;* S. America, ex. Herb. *Schweinitz*.

DOUBTFUL SPECIES

Megalonectria caespitosa Speg. Bol. Acad. Nat. Cien. Corb. **11**: 541. 1889.

This species has been distinguished by the larger spores which range from 30–45 × 10–12. The only specimen examined is from the herbarium of Prof. Bessey and according to the label was found on wood supporting a south Mexican orchid in the greenhouse at Lincoln, Nebraska.

14. ALLANTONECTRIA Earle; Greene, Plantae Bakerianae **2**: 11. 1901

Nectriella Sacc. (in part).

Perithecia bright colored, red, occurring in cespitose clusters on a stroma as in *Creonectria;* asci cylindrical to clavate, 8-spored; spores allantoid, simple, hyaline.

Type species: *Allantonectria Yuccae* Earle.

Distinguished from *Creonectria* by the simple spores which in the type species are allantoid in form.

1. ALLANTONECTRIA YUCCAE Earle l. c.

Perithecia densely cespitose in clusters of 12–20, seated on a stroma; perithecial clusters erumpent, thickly scattered or sub-

confluent, averaging about 1 mm. in diameter; perithecia bright red becoming dull red with age, subglobose, smooth, or minutely roughened, partially collapsing when dry, 100–125 mic. in diameter; asci clavate or cylindrical, 8-spored; spores 2-seriate or irregularly crowded, allantoid, 4–5 × 1 mic.

On dead leaves of *Yucca* sp.

TYPE LOCALITY: Hermosa, Colorado.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Colorado, *Baker* (type).

This species scarcely differs from Rouméguere's Fungi Sel. Exsicc., *6860* and Saccardo's Mycotheca Ital. *866* so far as we can see, both of which are labeled *Nectriella miltina* (Mont.) Sacc. The species however is probably distinct from that species, in which the spores are described as ovoid.

15. **Sphaerodermatella** gen. nov.

Stroma erumpent, fleshy; perithecia in dense cespitose clusters seated on the stroma which is entirely obscured at maturity, more or less rough and furfuraceous; asci broad-clavate to ovoid, 4–8-spored; spores simple becoming dark colored and opaque.

Distinguished from *Sphaeroderma* by the absence of effuse stroma and the cespitose arrangement of the perithecia.

1. **Sphaerodermatella Helleri** (Earle)

Melanospora (?) *Helleri* Earle, Muhlenbergia **1**: 13. 1901.

Sphaeroderma Helleri Sacc. & Sacc. Syll. Fung. **17**: 781. 1905.

Stroma erumpent; perithecia superficial, densely cespitose, 3 or 4–20 on an indistinct basal stroma, large, .5–1 mm. in diameter, deeply collapsing, grayish externally from irregular, flat, finally deciduous, wart-like projections apparently formed by the cracking of the hard outer layer; substance of the perithecial wall of a dark brown color, soft, composed of small-celled parenchyma; ostiolum slightly prominent when young, perforation obscure when collapsed; asci oblong, about 100 × 30 mic., soon evanescent; 4–8-spored; spores 2-seriate, elliptical, simple, at first hyaline, finally opaque and black, surrounded with a more or less distinct hyaline coating about 25–28 × 12–20 mic.; expelled and blackening the matrix when mature; paraphyses indistinct.

On bark of tree.

TYPE LOCALITY: Porto Rico.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Porto Rico, *Heller* (type).

16. **Creonectria** gen. nov.

Nectria Fries, Summa Veg. Scand. 387 (in part). 1849.

Stroma fleshy or subfleshy, tubercular or depressed, red, yellow, brown, or occasionally black (at least with age); perithecia globose or subglobose with the ostiolum often depressed with age, smooth, verrucose or furfuraceous, superficial on or surrounding the stroma; asci cylindrical, or clavate, 8-spored, with the spores occasionally accompanied by numerous other minute spore-like bodies in the ascus; spores 1–2-seriate or irregularly crowded, elliptical to fusoid, straight or curved, 1-septate, hyaline; paraphyses present or not evident.

Type species: *Tremella purpurea* L.

Distinguished from *Nectria* by the presence of a stroma. Conidial phase represented by *Tubercularia, Verticillium,* etc.

Perithecia some shade of red, scarlet, brick-red or brownish-black.
- Perithecia dull brick-red becoming brown or black with age.
  - Ascospores not accompanied by spore-like bodies in the ascus.
    - Perithecia verrucose, covered with coarse granules.
      - Stroma tubercular, prominent. — 1. *C. purpurea.*
      - Stroma concave, not rising above the surface of the substratum. — 2. *C. verrucosa.*
    - Perithecia smooth or only minutely rough, becoming black with age. — 3. *C. atrofusca.*
  - Ascospores accompanied by minute spore-like bodies in the ascus. — 4. *C. Coryli.*
- Perithecia scarlet or blood-red, becoming reddish-purple with age.
  - Spores elliptical or subelliptical with ends obtuse.
    - Perithecia collapsing with age.
      - Becoming truncate. — 5. *C. pithoides.*
      - Becoming pezizoid when collapsed. — 6. *C. rubicarpa.*
    - Perithecia entire; ostiolum very prominent. — 7. *C. mammoidea.*
  - Spores fusoid with ends acute or subacute.
    - Spores narrow-fusoid, 3 times as long as broad. — 8. *C. coccinea.*
    - Spores broad-fusoid, 2 times as long as broad.

Comparatively small, not more than 16 mic. long.
Perithecia vertically collapsing, on *Diatrypella*. 9. *C. nipigonensis.*
Perithecia mostly entire, on coniferous wood. 10. *C. Cucurbitula.*
Comparatively large, 20–25 mic. long. 11. *C. diploa.*
Perithecia pale rose-colored or some shade of yellow or yellowish-white.
Perithecia in cespitose clusters on the stroma.
Spores 10–14 × 3–3.5 mic.
Conidial phase profuse on decaying seeds. 12. *C. seminicola.*
Conidial phase consisting of isolated tubercular stromata. 13. *C. ochroleuca.*
Spores 12–14 × 5 mic. 14. *C. gramnicospora.*
Perithecia scattered over the surface of a tubercular stroma. 15. *C. tuberculariformis.*

1. **Creonectria purpurea** (L.)

Tremella purpurea L. Sp. Pl. **2**: 1158. 1753.
Sphaeria tremelloides Weigel. Obs. Bot. 46. 1772.
Tubercularia vulgaris Tode, Fungi Meckl. **1**: 18. 1790.
Sphaeria cinnabarina Tode, Fungi Meckl. **2**: 9. 1791.
Cucurbitaria cinnabarina Greville, Scot. Fl. Crypt. **3**: 136. 1825.
Nectria cinnabarina Fries, Summa Veg. Scand. 388. 1849.
Nectria Sambuci Ellis & Everh. Proc. Acad. Nat. Sci. Phil. **1890**: 246. 1891.
Nectria Meliae Earle, Bull. Torrey Club **25**: 364. 1898.
Nectria Russellii Berk. & Broome, Grevillea **4**: 45.
Nectria offuscata Berk. & Curtis, Grevillea **4**: 45.
Nectria nigrescens Cooke, Grevillea **7**: 50.
Sphaeria dematiosa Schw. Trans. Am. Phil. Soc. II. **4**: 205. 1832.
Sphaeria Celastri Schw.; Fries, El. Fung. **2**: 81. 1827.
Nectria purpurea (L.) Wilson & Seaver, Jour. Myc. **13**: 51. 1907.

Stroma erumpent, tubercular, at first pinkish or yellowish-red becoming darker with age, often brownish and occasionally quite black, 1–2 mm. in diameter and 1–2 mm. high; conidiophores 50–100 mic. long with short lateral branches on which the conidia are borne; conidia 4–6 × 2 mic., elliptical, hyaline; perithecia

springing at first from the base of the stroma which at maturity is concealed by the cespitose clusters of perithecia; individual perithecia nearly globose with the ostiolum rather prominent, becoming slightly collapsed, at first bright, cinnabar-red, becoming darker with age, often brown and occasionally black (when weathered); roughened externally with coarse granules 375–400 mic. in diameter; asci clavate, 8-spored, 50–90 × 7–12 mic.; spores mostly 2-seriate, elliptical, elongated, about 3 times as long as broad with the ends obtuse, 1-septate, hyaline, mostly a little curved, 12–20 × 4–6 mic.; paraphyses very delicate.

On bark of various kinds of deciduous trees and shrubs; *Acer, Amorpha, Ampelopsis, Berberis, Carya, Calycanthus, Celastrus, Cornus, Euonymus, Melia, Morus, Populus, Prunus, Pyrus, Quercus, Rhus, Ribes, Robinia, Rubus, Sambucus, Tilia, Ulmus.*

TYPE LOCALITY: Europe.

DISTRIBUTION: Maine to California and from Ontario to S. Carolina, probably common throughout N. America.

ILLUSTRATIONS: Tode, Fungi Meckl. *pl. 9, f. 68;* Tulasne, Fung. Carp. 3: *pl. 12;* E. & P. Nat. Pfl. Fam. 1^1: *f. 239,* A–D.; Winter, Rabenh. Krypt. Fl. 1^2: 87. *f. 1–3.*

EXSICCATI: Ellis, Fungi Nova Caesareenses, *68;* Ellis, N. Am. Fungi, *468;* Ellis & Everhart, Fungi Columbiani, *115;* Bartholomew, Fungi Columbiani, *2334, 2847*; Ravenel, Fungi Am. Exsicc. *339, 4119.*

Other specimens examined: Types or cotypes of the following synonyms have been examined: *Nectria Sambuci* Ellis & Everh., *Nectria Meliae* Earle, *Nectria Russellii* Berk. & Broome, *Nectria offuscata* Berk. & Curtis, *Nectria nigrescens* Cooke, *Sphaeria dematiosa* Schw., and *Sphaeria Celastri* Schw.

This is probably the most common and widely distributed species of the entire order and since it is very variable has been many times redescribed.

2. **Creonectria verrucosa** (Schw.)

Sphaeria verrucosa Schw. Trans. Am. Phil. Soc. II. 4: 204. 1832.

Nectria verrucosa Sacc. Syll. Fung. 2: 509. 1883.

Stroma fleshy, concave or convex, scarcely rising above the surface of the substratum; perithecia cespitose in clusters 1–2 mm. in diameter, erumpent through the outer bark; individual

perithecia nearly globose, dull red, very rough externally with coarse granules, 250–300 mic. in diameter; asci cylindrical to clavate, 8-spored, 50–65 × 5–6 mic.; spores 2-seriate, 1-septate, elliptical, with ends obtuse, straight or a little curved, usually not constricted, 12–16 × 4 mic.

On dead branches of *Morus, Sassafras* and *Melia.*

TYPE LOCALITY: Pennsylvania.

DISTRIBUTION: Delaware to N. Dakota and Alabama.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 12, f. 13–19.*

EXSICCATI: Ellis & Everhart, N. Am. Fungi, *2371.* Other specimens examined: Alabama, *Little;* Connecticut, *Thaxter;* Delaware, *Commons;* N. Jersey, *Ellis;* N. Dakota, *Seaver;* Pennsylvania, *Schweinitz* (type); S. Carolina, *Ravenel.*

Distinguished from *C. purpurea* (L.) Seaver only by the depressed stroma.

3. **Creonectria atrofusca** (Schw.)

Sphaeria atrofusca Schw. Trans. Am. Phil. Soc. II. 4: 206. 1832.
Nectria atrofusca Ellis & Everh. Jour. Myc. 1: 140. 1885.

Stroma fleshy or subfleshy, rather dark colored, erumpent but not rising much above the surface of the bark; perithecia in cespitose clusters on the stroma, clusters variable in size, averaging 1–2 mm., dark colored, nearly black in dried specimens, brownish-black with transmitted light, small mostly less than 200 mic. in diameter, subglobose with a prominent papilliform ostiolum, mostly collapsing when dry; asci subcylindrical, 45–50 × 7 mic., 8-spored; spores partially 2-seriate above, 1-seriate below, hyaline, 1-septate, slightly constricted at the septum, subfusoid with the ends slightly narrowed.

On dead branches of *Staphylea trifolia.*

TYPE LOCALITY: Pennsylvania.

DISTRIBUTION: Pennsylvania.

EXSICCATI: Ellis, N. Am. Fungi, *1547.* Other specimens examined: Pennsylvania, *Schweinitz* (type).

The species is distinguished by its host as well as the very dark colored perithecia.

4. **Creonectria Coryli** (Fuckel)

Nectria Coryli Fuckel, Symb. Myc. 180. 1869.
Chilonectria Coryli Ellis & Everh. N. Am. Pyrenom. 116. 1892.

Perithecia cespitose on an erumpent stroma, globose, smooth, at first bright red becoming blackish, entirely black in weathered specimens, collapsing becoming pezizoid; asci clavate, 85–100 × 10–12 mic., 8-spored but with spores often obscured by numerous, allantoid spore-like bodies which are present in the ascus; spores fusoid, 1-septate, with a short curved appendage at each end, 10–15 × 2.5–3 mic.

On branches of deciduous trees and shrubs; *Betula, Corylus, Crataegus, Lonicera, Populus, Rhus, Salix, Symphoricarpus.*

TYPE LOCALITY: Europe.

DISTRIBUTION: New Jersey to Ontario and N. Dakota.

EXSICCATI: Ellis, N. Am. Fungi, *159*. Other specimens examined: Delaware, *Commons;* New Jersey, *Ellis;* N. Dakota, *Brenckle;* Ontario, Canada, *Dearness.*

The species is very distinct in its spore characters.

5. **Creonectria pithoides** (Ellis & Everh.)

Nectria pithoides Ellis & Everh. Proc. Acad. Nat. Sci. Phil. **1890**: 247. 1891.

Stroma erumpent, yellowish; perithecia seated on the stroma in dense clusters 1.5–2.5 mm. in diameter, individual perithecia bright red, collapsing so as to become truncate, resembling the head of a barrel with the ostiolum appearing as a light translucent dot in the center, 200–250 mic. in diameter; asci cylindrival, 70–80 × 5 mic., 8-spored; spores elliptical, 1-septate, with an oil-drop in each cell, hyaline, 6–10 × 3–4 mic. (*pl. 13, f. 3–4*).

On bark of dead alders.

TYPE LOCALITY: British Columbia.

DISTRIBUTION: Known only from type locality.

EXSICCATI: Ellis & Everh. N. Am. Fungi, *2750* (cotype).

Distinguished by the bright red perithecia which are decidedly barrel-shaped when dry.

6. **Creonectria rubicarpa** (Cooke)

Nectria rubicarpa Cooke, Grevillea **7**: 50. 1878.

Perithecia cespitose in small, dense clusters, 1–2 mm. in diameter, minutely roughened, bright red becoming darker with age, collapsing and becoming deeply pezizoid; asci cylindrical to clavate, 55–60 × 6 mic., 8-spored; spores 1-seriate or partially 2-seriate above, elliptical, hyaline, 1-septate, 10–13 × 4–4.5 mic. scarcely constricted (*pl. 13, f. 11–12*).

On dead limbs of *Gelsemium* and stems of *Ilex*.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: New Jersey to Alabama.

EXSICCATI: Ellis, N. Am. Fungi, *80;* Ravenel, Fungi Am. Exsicc. *341*. Other specimens examined: Alabama, *Earle;* New Jersey, *Ellis*.

The species is distinguished by the dense clusters of collapsing perithecia and the small size of the spores.

7. **Creonectria mammoidea** (Phil. & Plow.)

Nectria mammoidea Phil. & Plow. Grevillea 3: 126. 1875.

Perithecia cespitose in clusters 1–3 mm. in diameter or more or less scattered, surrounding a brownish stroma, very large, averaging about 500 mic. in diameter, ovate, tapering above into a large, obtuse ostiolum, bright red with ostiolum often darker, shining, entire; asci cylindrical or slightly clavate, 100 × 7–8 mic., 8-spored; spores 1-seriate or partially 2-seriate above, oblique, subfusoid, 1-septate, usually slightly unequal-sided, 18–20 × 6–7 mic.

On wood and bark.

TYPE LOCALITY: England.

DISTRIBUTION: New Jersey to Ontario.

ILLUSTRATIONS: Grevillea 3: *pl. 42, f. 5*.

SPECIMENS EXAMINED: New Jersey, *Ellis;* Ontario, *Macoun;* also specimens from the herbarium of *Plowright*.

8. **Creonectria coccinea** (Pers.)

? *Sphaeria decidua* Tode, Fungi Meckl. 2: 31. 1791.

Sphaeria coccinea Pers. Ic. et Descr. 2: 47. 1800.

Nectria coccinea Fries, Summa Veg. Scand. 388. 1849.

Stroma yellowish, springing from the crevices of bark in irregular patches; perithecia cespitose in dense irregular clusters often several mm. in diameter, or occasionally scattered around the stroma; individual perithecia ovate with a prominent ostiolum, bright red, almost scarlet, color somewhat variable, smooth or very minutely roughened, mostly entire, about 300 mic. in diameter; asci cylindrical or clavate, 8-spored, 80–90 × 8–10 mic.; spores 1-seriate, fusoid, 12–16 × 4–5 mic.

On bark or more rarely on decorticated wood, *Acer, Fagus, Fraxinus, Magnolia, Melia, Ulmus,* etc.

TYPE LOCALITY: Europe.

DISTRIBUTION: Vermont to N. Dakota and W. Virginia, probably extending over a much wider range.

ILLUSTRATIONS: Pers. Ic. & Descr., *pl. 12, f. 2.*

EXSICCATI: Ellis, N. Am. Fungi, *161;* Ellis & Everh. N. Am. Fungi, *618;* E. Barholomew, Fungi Columbiani, *2043, 2238.* Other specimens examined: New York, *Clinton, Seaver;* N. Dakota, *Seaver;* N. Jersey, *Ellis;* Ontario, Canada, *Dearness;* Vermont, *Burt, Orton;* W. Virginia, *Orton.*

So far as we can see the species scarcely differs from *Nectria ditissima* Tul. If the two species are distinct, the characters are so poorly understood that they have been badly confused. The specimens examined which have been referred to these two names are identical.

9. **Creonectria nipigonensis** (Ellis & Everh.)

Nectria nipigonensis Ellis & Everh. Proc. Acad. Nat. Sci. Phil. 1893: 129. 1893.

Stroma depressed, yellowish, about .5 mm. in diameter; conidia minute, allantoid, 3–4 × 1 mic.; perithecia cespitose, nearly globose, about 250 mic. in diameter, reddish becoming darker with age, finally collapsing at the apex, smooth; asci cylindrical, 8-spored, 50–55 × 6–7 mic.; spores 1-seriate, fusoid or occasionally subelliptical, 1-septate, usually not constricted at the septum.

On the erumpent disc of *Diatrypella.*

TYPE LOCALITY: Lake Nipigon, Canada.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Canada, *Macoun* (type).

Distinguished by the pezizoid perithecia and broad-fusoid spores.

10. **Creonectria Cucurbitula** (Sacc.)

Nectria Cucurbitula Sacc. Michelia 1: 409. 1878. Not *N. Cucurbitula* (Tode) Fr.

Perithecial clusters erumpent and often very irregular in form, 1–2 mm. in diameter, consisting of numerous densely cespitose perithecia; individual perithecia bright red later becoming reddish-purple, ovate with a prominent rather obtuse ostiolum, entire or very rarely collapsing; asci cylindrical or clavate, 75–100 × 6–8 mic., 8-spored; spores at first crowded and partially 2-seriate, finally becoming 1-seriate, obliquely arranged with ends over-

lapping, broad-fusoid, rarely subelliptical, 1-septate and not constricted at the septum, hyaline, 14–16 × 5–7 mic. (mostly 15 × 7 mic.).

On bark of *Pinus, Abies* and *Larix*.

TYPE LOCALITY: Europe.

DISTRIBUTION: Newfoundland to New York and Ontario.

SPECIMENS EXAMINED: Newfoundland, *Waghorne;* New York, *Peck;* Ontario, Canada, *Macoun*.

The species is distinct both in external and internal characters.

11. **Creonectria diploa** (Berk. & Curtis)

Nectria diploa Berk. & Curtis, Jour. Linn. Soc. **10**: 378. 1869.

Perithecia in dense erumpent clusters about .5 mm. in diameter, individual perithecia minute, ovate, nearly smooth, bright red, finally collapsing; asci cylindrical, 8-spored; spores vertically 2-seriate, very large, fusoid, 1-septate, hyaline, with 2–4 oil-drops, 20–25 × 7–10 mic.

On bark of *Alnus* sp.

TYPE LOCALITY: S. Carolina.

DISTRIBUTION: Known only from type locality.

EXSICCATI: Ravenel, Fungi Car. Exsicc. 55.

Individual perithecia resemble those of *Nectria episphaeria* (Tode) Fries but differ in the very large size of the spores. The dense clusters of perithecia seem to indicate the presence of a stroma although the specimens are too old to show any definite stroma.

12. **Creonectria ochroleuca** (Schw.)

Sphaeria ochroleuca Schw. Trans. Am. Phil. Soc. II. **4**: 204. 1832.

Nectria ochroleuca Berk. Grevillea **4**: 16. 1875.

Nectria aureofulva Cooke & Ellis, Grevillea **7**: 8. 1878.

Nectria depauperata Cooke, Grevillea **7**: 50. 1878.

Nectria vulgaris Speg. Anal. Soc. Ci. Arg. **12**: 75. 1881.

Verticillium tubercularioide Speg. Anal. Soc. Ci. Arg. **12**: 125. 1881.

? *Nectria rhizogena* Grevillea **11**: 108. 1883.

Nectria pallida Ellis & Everh. Proc. Phil. Acad. Nat. Sci. **1894**: 325. 1894.

Stromata small, tubercular, 1–2 mm. in diameter, whitish to pink or flesh-colored, often floccose with the erect verticillate conidiophores; branches of the conidiophores ascending perpendicularly and each bearing at its summit a single conidium; conidia elliptical, hyaline, 5–8 × 3 mic. often granular within; perithecia occurring in dense clusters ranging from 3–5 to many perithecia, clusters very variable in form; individual perithecia small, nearly globose with the prominent papilliform ostiolum, smooth or only minutely rough, at first flesh-colored, when dry becoming pale yellow or almost white, 200–300 mic. in diameter, entire or occasionally collapsing becoming pezizoid; asci clavate, 8-spored, 50 × 5–7 mic.; spores 2-seriate above, 1-seriate below or often irregularly crowded, fusoid with ends acute, a little constricted at the septum, hyaline, 8–12 × 3–4 mic.

On bark of various kinds of trees, *Andromeda, Betula, Carpinus, Carya, Clethra, Citrus, Laurus, Magnolia, Platanus, Salix,* also on *Yucca* and old stump of *Musa.*

TYPE LOCALITY: Pennsylvania.

DISTRIBUTION: New York to Missouri and Louisiana.

EXSICCATI: Ellis, N. Am. Fungi, *677, 574.* Ravenel, Fungi Am. Exsicc. *645.* Other specimens examined: Delaware, *Commons;* Missouri, *Demetrio* (type of *N. pallida* Ellis & Everh.); New York, *Seaver, Shear;* Pennsylvania, *Schweinitz* (type of *Sphaeria ochroleuca* Schw.); also cotype of *N. aureofulva* Cooke & Ellis, specimens of *N. depauperata* determined by M. C. Cooke, and specimens of *N. vulgaris* Speg. and *Verticillium tubercularioide* Speg. both from the herbarium of Spegazzini.

The species seems to be very common in the east and south and has been collected by the writer on several kinds of trees and shrubs about New York City. The perithecial clusters are quite variable in size and form and the perithecia themselves variable in color but the species may usually be recognized by the pale perithecia and small, fusoid spores.

13. **Creonectria seminicola** (Seaver)

Nectria seminicola Seaver, Mycologia 1: 21. 1909.

Conidial phase consisting of white mycelial growth covering the substratum, finally heaping up at various points forming pinkish stromata; conidiophores erect, much branched with branches ascending perpendicularly, each bearing at its summit a single elliptical, hyaline, conidium; conidia 5–7 × 2–3 mic., with 1–2 oil-

drops; perithecia cespitose in dense clusters with the clusters often becoming confluent and covering the most of the exposed surface of the substratum; individual perithecia nearly globose with a minute papilliform ostiolum, smooth or nearly so, 250 mic. in diameter, at first flesh-colored to orange, fading in drying to pale yellow or whitish; asci clavate, 40–50 mic. long, 8-spored; spores mostly 2-seriate or irregularly crowded, hyaline, 1-septate, a little constricted at the septum, $10–14 \times 3–3.5$ mic. (*pl. 13, f. 5–7*).

On partially decayed seeds of skunk cabbage, *Spathyema foetida* and also on seeds of cultivated beans which are partially decayed.

TYPE LOCALITY: New York City.

DISTRIBUTION: Known only from type locality.

ILLUSTRATIONS: Mycologia **1**: *pl. 2, f. 5–9*.

SPECIMENS EXAMINED: New York, *Seaver* (type).

The perithecial and spore characters of this species are identical with those of the preceding with which specimens were carefully compared before describing the species originally. Since describing the present species other information gained in the field has suggested that possibly the two are identical. Attempts to prove the identity of the two species by culture have failed.

14. **Creonectria gramnicospora** (Ferd. & Wge.)

Nectria grammicospora Ferd. & Wge. Bot. Tidsskrift **29**: 11. 1908.

Stromata pulvinate, erumpent; perithecia cespitose, clusters variable in size; individual perithecia subglobose, $300–350 \times 200–250$ mic. in diameter, fleshy-membranaceous, pallid-ochraceous, slightly white furfuraceous near the base; asci clavate, above truncate, subsessile, $35–60 \times 8.5–10$ mic., 8-spored; spores 2-seriate above, 1-seriate below, ellipsoid, slightly unequal-sided, $12–14 \times 5$ mic.

On bark of branches.

TYPE LOCALITY: Island of St. Thomas.

DISTRIBUTION: Known only from type locality.

ILLUSTRATIONS: Bot. Tidssk. **29**: *pl. 1, f. 3*.

SPECIMENS EXAMINED: St. Thomas, Raunkier *3103* (cotype).

Similar in general appearance to the two preceding species but spores larger with some differences in size of perithecia and other gross characters.

15. **Creonectria tuberculariformis** (Rehm)

Hypocrea tuberculariformis Rehm, Ber. Naturh. Ver. Augsburg **26**: 106. 1881.

Nectria tuberculariformis Winter; Rabenh. Krypt. Fl. 1^2: 118. 1887.

Hypocreopsis tuberculariformis Sacc. Syll. Fung. 9: 981. 1891.

Stroma tubercular, rounded or more often elongated, nearly smooth or in dried specimens often longitudinally striated, pinkish or rose-colored becoming dull red with age; perithecia superficial, solitary or more or less crowded, small, averaging about 200 mic. in diameter, smooth or nearly so, globose with a rather prominent papilliform ostiolum becoming slightly collapsed from above when dry; asci clavate, 8-spored, 40–50 × 6–7 mic.; spores 1–2-seriate, mostly 2-seriate above and 1-seriate below, usually a little broader above, fusoid, 1-septate and a little constricted at the septum, with small oil-drops in each cell, 8–11 × 3–4 mic. (*pl. 13, f. 8–10*).

On dead stems of *Urtica* sp., more rarely on old branches and dung.

TYPE LOCALITY: Germany.

DISTRIBUTION: N. Dakota.

SPECIMENS EXAMINED: N. Dakota, *Seaver* (various collections); also Rehm, Ascomycetes, *435*, *679* (including cotype).

The conidial phase of this fungus was collected commonly in North Dakota but the mature perithecia were less common. The species is very different in the arrangement of the perithecia from any of the other species of the genus.

DOUBTFUL SPECIES

Nectria muscivora (Berk. & Br.) Cooke, Handbk. Brit. Fungi **2**: 786. 1871.

Sphaeria muscivora Berk. & Br. Ann. Mag. Nat. Hist. **6**: 188. 1851. *Calonectria muscivora* Sacc. Michelia 1: 315. 1878.

"Mycelium forming white, lanose patches 2 inches or more in diameter and rapidly destroying the moss on which it grows. Perithecia collected in little groups more or less connate, half immersed in the mycelium, bright orange, ovate, sometimes collapsing laterally, orifice papillaeform. Asci clavate; sporidia elliptical, pointed at either end, with a central septum, and the endochrome in either articulation bipartite, so that they are probably three-septate when the sporidia are quite mature."

Specimens distributed in Ravenel's Fungi Car Exsic. 57 and Ellis' N. Am. Fungi 1333, both of which have been incorrectly referred to this name, are apparently good specimens of *Sphaerostilbe coccophila* (Desm.) Tul. The type of the present species has not been seen.

Nectria infusaria Cooke & Hark. Grevillea **12**: 101. 1884.

Stroma (*Fusarium*) pulvinate, pale red; conidia curved, 3-septate, hyaline, 30–40 × 2.5 mic.; perithecia cespitose, erumpent, pallid-red, few in number, soft-membranaceous, subconfluent, smooth, 5–10 on a stroma; asci cylindrical, 8-spored; spores 1-seriate, elliptical, 1-septate, not constricted, hyaline, 10 × 4–5 mic.

On *Acacia* twigs, California. No specimen has been seen.

Nectria Ipomoeae Halst. Rep. N. Jersey Agric. Exp. Sta. **12**: 281. 1891.

Conidial phase consisting of a *Fusarium;* perithecia cespitose, globose-conical, verrucose-squamulose, red; asci clavate, 8-spored; spores elliptical, 1-septate, slightly constricted, hyaline.

On roots and stems of eggplant.

A note from Mr. Halsted states that the type of this species was probably destroyed. The species seems to be well characterized although no specimens in good condition have been available for examination.

Nectria Bainii Massee, Bull. Royal Gardens Kew **1899**: 5. 1901.

Perithecia gregarious, seated on a yellowish-red or orange-colored mycelium, globose, red, hairy, finally naked above, 300–350 mic. in diameter; asci clavate-cylindrical, shortly stipitate, 8-spored, 80–90 × 7–9 mic.; spores partially 2-seriate, oblong-elliptical or subacute, 1-septate, 10–12 × 5 mic., hyaline.

Parasitic on cacao pods, Trinidad.

A cotype specimen of this species from Kew is too minute to permit fair examination.

Nectria ditissima Tul. Fung. Carp. **3**: 73. 1865.

American specimens referred to this name do not differ so far as we can see from *Nectria coccinea* (Pers.) Fries.

Nectria citisporina Ellis & Everh. Erythea **1**: 197. 1893.

Nectria microspora Cooke & Ellis, Grevillea **5**: 53. 1876.

17. Macbridella gen. nov.

Perithecia in dense cespitose clusters seated on a stroma, bright colored, reddish or yellowish, becoming darker with age, globose to subcylindrical, collapsing or entire; asci cylindrical-clavate, 8-spored; spores elliptical or fusoid, 1-septate, at first hyaline, becoming smoky-brown to brownish-black.

Type species: *Nectria chaetostroma* Ellis & Macbr.

Distinguished from *Creonectria* by the colored spores. The subgeneric name *Phaeonectria* was proposed by Saccardo and based on one of the species here described. Since both of the North American species included in this genus were collected on a botanical expedition sent out from the State University of Iowa, both were originally described in the Bulletin of the Laboratories of Natural History of that Institution, and the type of the genus bears the name of Professor T. H. Macbride as its coauthor, it seems appropriate that the genus should be named in his honor.

Spores small, 18–20 × 7–8.5 mic.; perithecia surrounded with hairs. 1. *M. chaetostroma.*
Spores large, 35–48 × 10–12 mic.; perithecia not surrounded with hairs. 2. *M. striispora*

1. Macbridella chaetostroma (Ellis & Macbr.)

Nectria chaetostroma Ellis & Macbr.; Ellis & Everh.; Bull. Lab. Nat. Hist. St. Univ. Iowa 4: 70. 1896.

Perithecia in dense irregular clusters 1–5 mm. in diameter, clusters often elongated; individual perithecia globose or subglobose, dark reddish-brown, becoming brownish-black, slightly collapsing becoming pezizoid, surrounded at the base with a growth of brown, crooked, septate hairs, 100–200 mic. long and 3–4 mic. thick; asci clavate, 75–80 × 10 mic., 8-spored; spores 2-seriate or rather irregularly crowded in the ascus, elliptical, straight or curved, 1-septate, slightly constricted, with a distinct oil-drop in each cell, pale brown, 18–20 × 7–8.5 mic.; paraphyses filiform.

On bark of undetermined tree or shrub.

TYPE LOCALITY: Central America.

DISTRIBUTION: Known only from type locality.

EXSICCATI: C. L. Smith, Nicaragua Fungi, *206* (cotype).

"The first appearance is a tuft of dark brown hairs, which are finally hidden and almost obliterated by the densely crowded perithecia 10–40 in number in a compact group 1–4 mm. across."

2. **Macbridella striispora** (Ellis & Everh.)

Nectria striispora, Ellis & Everh. Bull. Lab. Nat. Hist. St. Univ. Iowa 2: 398. 1893.

Perithecia in irregular, dense, cespitose clusters as large as 5 mm. in diameter, consisting of 20–100 perithecia each; individual perithecia subcylindrical, tapering above into an obtuse ostiolum which in mature specimens is quite prominent, at first covered with a yellowish furfuraceous coat, finally amber; asci clavate, tapering above, about 100 × 15 mic., 8-spored; spores crowded in the ascus, large, fusoid, straight or curved, 1-septate, with several large oil-drops in each cell, slightly constricted at the septum, pale brown, becoming striated, 35–48 × 10–12 mic.; paraphyses indistinct.

On bark and rotten wood.

TYPE LOCALITY: Central America.

DISTRIBUTION: Known only from type locality.

EXSICCATI: C. L. Smith, Central Am. Fungi, *6*.

The spores in this species resemble in size and color the teleutospores in some of the common rusts. The striations are quite prominent but do not appear to roughen the outer surface but to be due to some internal markings or contents.

18. GIBBERELLA Sacc. Michelia 1: 43 (in note). 1879

Stromata (*Fusarium*) tubercular or more or less effuse; perithecia cespitose or occasionally scattered on or surrounding the stromata; asci clavate, 8-spored, spores fusoid; 3–many-septate, hyaline.

Type species: *Sphaeria pulicaris* Fries.

1. GIBBERELLA PULICARIS (Fries); Sacc. Michelia 1: 43 (in note). 1879

Sphaeria pulicaris Fries; Kunze & Schm. Myk. Hefte 2: 37. 1823.

Gibbera pulicaris Fries, Summa Veg. Scand. 402. 1849.

Botryosphaeria pulicaris Ces. & Not. Comm. Soc. Critt. It. 1: 212. 1863.

Perithecia in cespitose clusters .5–1 mm. in diameter, seated on a stroma or occasionally more or less scattered around it, ovate with a rather prominent ostiolum, minutely rough, finally collapsing, black to the unaided eye, blue with transmitted light; asci

clavate, tapering above, 8-spored, 50–55 × 10 mic.; spores crowded in the ascus, fusiform, straight or curved, 3-septate, hyaline or slightly yellowish, 18–20 × 5–6 mic.

On corn stalks, herbaceous stems and bark of trees and shrubs.

TYPE LOCALITY: Europe.

DISTRIBUTION: New Jersey to N. Dakota, Kansas and W. Virginia.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 13, f. 1–6;* E. & P. Nat. Pfl. Fam. *f. 240,* G–J.

EXSICCATI: Ellis, N. Am. Fungi, *81;* Wilson & Seaver, Ascom. & Lower Fungi, *32.* Other specimens examined: N. Jersey, *Ellis, Commons;* W. Virginia, *Nuttall;* Iowa, *Seaver;* N. Dakota, *Seaver.*

DOUBTFUL SPECIES

Gibberella Saubinetii (Durien & Mont.) Sacc. Michelia **1**: 513. *Sphaeria Saubinetii* Durien & Mont.; Durien; U. Alger. Crypt. **1**: 479. 1846? *Gibbera Saubinetii* Mont. Syll. Crypt. 252. 1856.

Gibberella ficini (Cooke & Hark.) Ellis & Everh. N. Am. Pyrenom. 120. 1892.

19. **Scoleconectria** gen. nov.

Ophionectria Sacc. (in part).

Stroma subglobose, tubercular or depressed; perithecia superficial on or surrounding the stroma, in dense clusters or more or less evenly scattered; asci 2–8-spored, cylindrical to clavate; spores 3–many-septate, fusoid to subfiliform, hyaline, or subhyaline.

Type species: *Ophionectria scolecospora* Bref.

Distinguished from *Creonectria* by the many-septate spores and from *Ophionectria* by the presence of a stroma. Characterized by its worm-like spores.

Spores filiform or subfiliform, very long.
  On dead branches of *Pinus;* spores 40–50 × 2.5–3 mic. — 1. *S. scolecospora.*
  On scale insects; spores clavate, 100–120 × 6–7 mic. — 2. *S. coccicola.*
Spores fusoid or subelliptical, comparatively short.
  Stroma prominent, tubercular, 1–2 mm. high. — 3. *S. canadensis.*
  Stroma depressed, inconspicuous.
    Spores subelliptical, curved. — 4. *S. polythalama.*

Spores fusiform or subfusiform.
Perithecia red; ascospores accompanied by smaller spore-like bodies. 5. *S. balsamea.*
Perithecia yellowish to brownish; spore-like bodies absent. 6. *S. Atkinsonii.*

1. **Scoleconectria scolecospora** (Bref.)

? *Nectria cylindrospora* Sollm. Bot. Zeit. **22**: 265. 1864.
Ophionectria scolecospora Bref. Unters. Myk. **10**: 178. 1891.
Chilonectria Cucurbitula Ellis & Everh. N. Am. Pyrenom. 116. 1892.

Perithecial clusters quite regular, rounded, composed of numerous, densely cespitose perithecia; individual perithecia dull red at first slightly furfuraceous, becoming quite smooth, nearly globose, finally collapsing becoming pezizoid; asci clavate to cylindrical, 60–75 × 8–10 mic., filled with numerous spore-like bodies, often obscuring the long cylindrical spores; spores usually more or less curved, many-septate with the septa transverse or extending irregularly, delicate, 40–50 × 2.5–3 mic.

On branches of different species of *Pinus.*

TYPE LOCALITY: Germany.

DISTRIBUTION: New Jersey.

ILLUSTRATIONS: Brefeld, Unters. Myk. **10**: *pl. 5, f. 45;* Ellis & Everh. N. Am. Pyrenom. *pl. 12, f. 9–12;* E. & P. Nat. Pfl. Fam. 1^1: *f. 241,* D.

EXSICCATI: Ellis & Everh. N. Am. Fungi, *1551.*

Distinguished by the long cylindrical spores with the accompanying minute spore-like bodies. The species cannot be distinguished on gross characters.

No type specimen of this species has been examined but the description and illustration by Brefeld leave little doubt as to its identity. The species has been confused with other species occurring on the same habitat and with similar gross characters.

2. **Scoleconectria coccicola** (Ellis & Everh.)

Nectria coccicola Ellis & Everh. Jour. Myc. **2**: 39. 1886.
Dialonectria coccicola Ellis & Everh. Jour. Myc. **2**: 137. 1886.
Ophionectria coccicola Berl. & Vog.; Sacc. Syll. Add. **4**: 218. 1886.

Stroma rounded, more or less prominent, whitish; conidia borne in clusters of 3–5, large, broad at the base, tapering into a bristle-like apex, 15–20-septate, 100–150 × 7–7.5 mic. with a distinct stem-like base; perithecia in cespitose clusters, nearly globose or a little longer than broad, reddish becoming dark brownish, minutely roughened, at first clothed with a few hyaline hairs, then naked, 300–500 mic. in diameter; asci cylindrical, tapering below into a stem-like base, 150–200 × 20 mic.; spores clavate or subcylindrical, 100–120 × 6–7 mic. at the base, 15–20-septate, hyaline.

On dead scale insects on the bark of living orange trees.

TYPE LOCALITY: Florida.

DISTRIBUTION: Florida and Cuba.

ILLUSTRATIONS: Bull. Fl. Agric. Exp. Sta. 94: 12, *f. 8–14*.

SPECIMENS EXAMINED: Florida, *Southworth* (type).

The conidia of this species resemble very closely both in size and form the ascospores but are much more acutely pointed and may also be distinguished by the manner in which they are borne.

3. **Scoleconectria canadensis** (Ellis & Everh.)

Nectria canadensis Ellis & Everh. Bull. Torrey Club **11**: 74. 1884.

Calonectria canadensis Berl. & Vog.; Sacc. Syll. Fung. Add. 212. 1886.

Stroma (*Tubercularia*) 1–2 mm. high, with an orange head and dull red base; conidia minute, elliptical, hyaline, about 5 × 2 mic.; perithecia springing in dense clusters from the base of the stroma, finally surrounding and often covering it; individual perithecia nearly globose, brick-red, 250–300 mic. in diameter, at first tubercular and rough finally becoming more or less smooth and slightly collapsing; asci clavate, 75–100 × 12–15 mic., 8-spored; spores crowded, elliptical, straight or curved, hyaline, 3-septate, 18–20 × 7 mic. (*pl. 13, f. 13–14*).

On the bark of *Ulmus* sp.

TYPE LOCALITY: Ontario, Canada.

DISTRIBUTION: Reported only from type locality.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 13, f. 7–14*.

EXSICCATI: Ellis & Everh. N. Am. Fungi, *2547;* Ellis & Everh. Fungi Columbiani, *226*. Other specimens examined: Ontario, Canada, *Dearness,* various collections.

The species is distinct in its prominent stroma.

4. **Scoleconectria polythalama** (Berk.)

Nectria polythalama Berk.; Hooker's Fl. N. Zealand **2**: 203. 1853.

Nectria auriger Berk. & Rav. Grevillea **4**: 46. 1875.

Calonectria polythalama Sacc. Michelia **1**: 308. 1878.

Perithecia erumpent in dense clusters 1–2 mm. long and about 1 mm. broad; seated on a yellowish stroma; individual perithecia subglobose, at first covered with a yellowish-green coat of powdery material which finally disappears leaving the perithecia of a dull red color, finally collapsing; asci cylindrical or clavate, 50–60 × 12–15 mic., 8-spored; spores crowded, elliptical, curved, yellowish-hyaline, 7-septate (mostly), 18–22 × 5 mic.

On *Chionanthus, Fraxinus* and *Liquidambar.*

TYPE LOCALITY: New Zealand.

DISTRIBUTION: Virginia to Alabama.

ILLUSTRATIONS: Brekeley, Hooker's Fl. N. Zealand **2**: *pl. 116, f. 15.*

EXSICCATI: Ellis, Fungi Nova Caesareenses, *69;* Ellis, N. Am. Fungi, *79;* Ravenel, Fungi Car. Exsicc. *54, 60.* Other specimens examined: Virginia, *Commons.*

The perithecia are greenish in some specimens and reddish in others, the difference in color being due to the presence or absence of the greenish powdery material with which the perithecia are clothed. This difference in color seems to have been the distinguishing character of the two species, *N. polythalama* Berk. and *N. auriger* Berk. & Rav.

5. **Scoleconectria balsamea** (Cooke & Peck)

Nectria balsamea Cooke & Peck, Ann. Rep. N. Y. State Mus. **26**: 84. 1874. Grevillea **12**: 81. 1884.

? *Calonectria Cucurbitula* Sacc. Michelia **1**: 312. 1878.

Calonectria balsamea Sacc. Syll. Fung. **9**: 986. 1891.

Perithecial clusters small, 1–2 mm. in diameter, erumpent through the outer bark; individual perithecia nearly globose smooth or only minutely rough, red; in dried specimens dull brick-red, entirely collapsing, becoming pezizoid; asci cylindrical to clavate, at first filled with numerous minute, spore-like bodies about 2 × 1 mic. among which are several (2–4) true spores; spores fusiform, 5–6-septate, granular within, 15–25 × 4–5 mic.

On the branches of *Abies balsamea*.

TYPE LOCALITY: North Elba, New York.

DISTRIBUTION: New York to Minnesota and Newfoundland.

SPECIMENS EXAMINED: Minnesota, *Arthur, Bailey & Holway;* Newfoundland, *Waghorne;* New York, *Peck*.

Distinguished by the fusiform, many-septate spores.

On gross characters the species cannot be distinguished from *Scoleconectria scolecospora* (Bref.) Seaver, however the habitat of the two species is different and this so far as our observations have gone is constant. The spore characters of the two species are very different.

From the presence of the minute spore-like bodies which often obscure the true ascospores this species is also likely to be confused with *Nectria Coryli* Fuckel.

Chilonectria Rosellinii (Carest.) Sacc. may also be identical with this species but in the absence of specimens it is impossible to determine.

6. **Scoleconectria Atkinsonii** (Rehm)

Calonectria Atkinsonii Rehm, Ann. Myc. 2: 178. 1904.

Perithecia erumpent in dense clusters 1–2 mm. in diameter; individual perithecia subconical, tapering into a prominent obtuse ostiolum, at first densely yellow-furfuraceous with the ostiolum bare and darker-colored, finally becoming bare and dark brownish-black; asci clavate with a subtruncate apex and slender stem-like base, $90–100 \times 15–17$ mic., 8-spored; spores fusoid or subfusiform, at first 1-septate becoming 3-septate and constricted at the middle septum, mostly curved, hyaline or subhyaline, $27–33 \times 8–9$ mic.; paraphyses filiform, 3 mic. in diameter.

On dead branches of *Acer, Crataegus, Tilia,* etc.

TYPE LOCALITY: New York.

DISTRIBUTION: New York to Ontario, Canada.

EXSICCATI: Ellis & Everh. Fungi Columbiani, *2006* (as *Calonectria chlorinella* (Cooke) Ellis & Everh.). Other specimens examined: New York, *Atkinson 5240* (cotype), *Cooke;* Ontario, Canada, *Dearness*.

The species was described by Ellis & Everh. N. Am. Pyrenom. *113* as *Calonectria chlorinella* (Cooke) Ellis & Everh., with which species it has often been confused.

20. ECHINODOTHIS Atk.; Bull. Torrey Club **21**: 224. 1894

Stroma subfleshy or corky, light colored, pulvinate to subglobose or irregular in form, often constricted at the base, sometimes entirely surrounding the host, consisting or several layers of different consistency; perithecia superficial, scattered, subcylindrical, sessile, giving an echinulate appearance to the stroma; asci cylindrical, 8-spored; spores linear, septate, at length separating at the septa into short segments.

Type species: *Hypocrea tuberiformis* Berk. & Rav.

1. ECHINODOTHIS TUBERIFORMIS (Berk. & Rav.) Atk. Bull. Torrey Club **21**: 224. 1894

Hypocrea tuberiformis Berk. & Rav. Grev. **4**: 13. 1875.

Dussiella tuberiformis Patouillard, Soc. Myc. France **6**: 107 (in part). 1890.

Hypocrella tuberiformis Atkinson, Bot. Gaz. **16**: 282. 1891.

Stroma subglobose, 1 cm. or more in diameter, entire, lobed or divided, seated upon the reed or upon the leaf sheath and fastened by a whitish mycelium consisting of radiating threads which are sometimes tinged yellowish brown; substance leathery or corky, consisting of three layers, an inner layer white to pinkish, an intermediate layer light ochre and an outer layer cinnamon; stroma externally dark brownish becoming black; conidiophores needle-shaped; conidia oval to fusoid, 3–4 × 7–10 mic.; perithecia entirely superficial in small clusters or evenly distributed over the exposed surface of the stroma; subconical in form, giving the whole stroma a spiny appearance; clothed except the apex with a dense covering of minute threads which are at first whitish becoming cinnamon-colored, the naked apex becoming black, about .3 × 1 mm.; asci 8-spored cylindrical, with a swelling at the apex, very large, 475–750 × 14–20 mic.; spores nearly as long as the ascus, hyaline or slightly yellowish, many-septate, joints 15 × 4–5 mic. (*pl. 13, f. 15*).

On stems of *Arundinaria*.

TYPE LOCALITY: South Carolina.

DISTRIBUTION: South Carolina to Alabama.

ILLUSTRATIONS: Atkinson, Bot. Gaz. **16**: *pl. 25*.

EXSICCATI: Ravenel, Fungi Am. Exsicc. *733*. Other specimens examined: Alabama, *Atkinson 2218;* South Carolina, *Ravenel 619*.

The first description of this species was evidently drawn from

sterile specimens which probably accounts for its having been placed in the genus *Hypocrea.* A note from Kew made from examination of Berkeley and Ravenel's specimen No. 1220 states "no spores visible." Small cavities beneath the surface of the stroma were evidently mistaken for the perithecia. This is the number from which the description was drawn in Grevillea 4: 13.

Other specimens examined from the Ravenel collection show mature perithecia. The spore characters suggest *Hypocrella* or *Epichloe* but the superficial position of the perithecia bar it from either of those genera in both of which the perithecia are entirely immersed or with the necks slightly protruding.

21. THYRONECTRIA Sacc. Grevillea 4: 21. 1875

Pleonectria Sacc. Nuov. Giorn. Bot. It. 8: 178. 1876.

Stroma erumpent-superficial or subimmersed with the perithecia in dense cespitose clusters; individual perithecia subglobose, smooth or rough or often clothed with a yellowish-green, furfuraceous coat which sometimes disappears with age leaving the perithecia dark colored, red to brownish, collapsing or entire; asci 8-spored, cylindrical to clavate; spores hyaline, when mature many-septate and muriform, often accompanied by minute spore-like bodies which are much smaller in size.

Type species: *Thyronectria Patavina* Sacc.

Distinguished by the muriform, hyaline spores.

Spores elliptical, 2 times as long as broad.	
Perithecia subimmersed, greenish.	1. *T. pyrrhochlora.*
Perithecia erumpent-superficial, not green.	
Perithecia dark brownish; spores small, 10–15 × 7–9 mic.	2. *T. denigrata.*
Perithecia reddish; spores large, 16–30 mic. long.	
Spores 20–30 × 10–12 mic., on bark of *Carya.*	3. *T. missouriensis.*
Spores 16–20 × 7–8 mic., on *Ribes.*	4. *T. berolinensis.*
Spores subelliptical, accompanied by minute spore-like bodies.	5. *T. sphaerospora.*

1. THYRONECTRIA PYRRHOCHLORA (Auers.) Sacc. Michelia 1: 325. 1878

Nectria pyrrhochlora Auers. Hedwigia 8: 88. 1869.

Valsa Xanthoxyli Peck, Ann. Rep. N. Y. St. Mus. 31: 49. 1879.

Pseudovalia xanthoxyli Sacc. Syll. Fung. **2**: 137. 1883.

Fenestella Xanthoxyli Sacc. Syll. Fung. **2**: 332. 1883.

Pleonectria pyrrhochlora Winter; Rabenh. Krypt. Fl. 1^2: 108. 1887.

Thyronectria virens Hark.; Ellis & Everh. N. Am. Pyrenom. 92. 1892.

Thyronectria Xanthoxyli Ellis & Everh. N. Am. Pyrenom. 92. 1892.

Perithecia cespitose in rounded or elongated clusters, seated on the inner bark, finally bursting through the epidermis, becoming more or less superficial, often so densely cespitose that the perithecia appear to be united, at first covered with a thin olive-green tomentum, or powdery material, with the ostiolum protruding and bare, the entire perithecium becoming more or less bare with age, about 300 mic. in diameter; asci clavate, 100–125 mic. long, 8-spored; spores crowded, elliptical, straight or curved, hyaline or slightly yellowish, many-septate and muriform, 18–24 × 7–8 mic.

On branches of *Acer, Fraxinus* and *Xanthoxylum.*

TYPE LOCALITY: Europe.

DISTRIBUTION: New York to Ontario and Ohio.

EXSICCATI: Ellis & Everh. N. Am. Fungi, *2546, 3310.* Other specimens examined: Ohio, *Morgan;* Ontario, *Dearness 1484.*

2. **Thyronectria denigrata** (Winter)

Pleonectria denigrata Winter, Bull. Torrey Club **10**: 49. 1883.

Perithecia erumpent in very dense, large, rounded clusters 2–5 mm. in diameter, seated on a brownish stroma; individual perithecia nearly globose, minutely roughened, dark brownish with a prominent, black, shining ostiolum finally becoming black, 350–450 mic. in diameter; asci cylindrical, 50–70 × 8–10 mic., 8-spored; spores 1-seriate or crowded, short elliptical, hyaline or slightly yellowish, 3–5-septate, becoming muriform, often a little constricted, 10–15 × 7–9 mic.

On branches of *Gleditschia triacanthos.*

TYPE LOCALITY: Lexington, Kentucky.

DISTRIBUTION: Delaware to Kansas and Kentucky.

EXSICCATI: Ellis, N. Am. Fungi, *1334;* Ellis & Everh. N. Am. Fungi, *2372.* Other specimens examined: Delaware, *Commons;* Kansas, *Bartholomew;* Kentucky, *Kellerman;* Missouri, *Webber;* Ohio, *Morgan.*

3. **Thyronectria missouriensis** (Ellis & Everh.)

Nectria missouriensis Ellis & Everh. Jour. Myc. 4: 57. 1888.

Pleonectria missouriensis Sacc. Syll. Fung. 9: 990. 1891.

Paronectria missouriensis Rabenhorst-Winter, Fungi Europaei, *3748.* 1891.

Perithecia cespitose on the stroma in clusters of 6–20, dull red, nearly globose, smooth or minutely rough, with a prominent ostiolum, usually not collapsing, 250–300 mic. in diameter; asci clavate, 100–120 × 12–15 mic., 8-spored; spores crowded irregularly in the ascus, large, elliptical, straight or a little curved, hyaline or very slightly yellowish, 6–7-septate, with several longitudinal septa, dividing the spore into numerous small cells, 20–30 × 10–12 mic.

On bark of *Carya.*

TYPE LOCALITY: Concordia, Missouri.

DISTRIBUTION: Delaware to Missouri.

SPECIMENS EXAMINED: Missouri, *Demetrio 276.*

Distinguished from *T. berolinensis* (Sacc.) Seaver by the larger size of the spores as well as by the difference in host and a slight variation in perithecial characters.

4. **Thyronectria berolinensis** (Sacc.)

Nectria Ribis Niessl, Verh. Nat. Ver. Brumm 2: 114 (homonym). 1865.

Pleonectria berolinensis Sacc. Michelia 1: 123. 1878.

Pleonectria Ribis Karst. Medd. Soc. Fauna Fl. Fenn. 5: 42. 1879.

Perithecia erumpent in large cespitose clusters 1–3 mm. in diameter on a stroma which becomes indistinct in aged specimens; individual perithecia dull brick-red becoming darker with age and often quite black, smooth or nearly so, entirely collapsing becoming pezizoid with age, 250–300 mic. in diameter; asci cylindrical-clavate, 8-spored; spores 1-seriate, elliptical, 5–9-septate and muriform, hyaline or very slightly yellowish, 16–20 × 7–8 mic.

On dead branches of *Ribes* (wild and cultivated).

TYPE LOCALITY: Germany.

DISTRIBUTION: Massachusetts to Montana.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 12, f. 7–8.*

EXSICCATI: *Ellis,* N. Am. Fungi, *470;* Ellis & Everh. Fungi

Columbiani, *26*, *470*. Other specimens examined: Montana, *Anderson 396;* Iowa, *Holway;* Massachusetts, *Farlow;* N. Dakota, *Seaver* (various collections).

5. **Thyronectria sphaerospora** (Ellis & Everh.)

Nectria sphaerospora Ellis & Everh.; Bessey & Webber, Ann. Rep. Neb. St. Board Agric. 1889: 193. 1890.

Chilonectria crinigera Ellis & Everh. Proc. Acad. Nat. Sci. Phil. 1890: 246. 1891.

Perithecia cespitose on a tubercular stroma in small clusters of 3–12 each; individual perithecia subglobose, papillate, minutely rough, at first covered with a brownish furfuraceous coat, finally bare and nearly black, slightly collapsing or entire, about 300–400 mic. in diameter; asci clavate, about 50–70 × 12–15 mic. at first filled with numerous minute spore-like bodies 2–3 × 1 mic., among which are the true spores, 8 in each ascus; ascospores subglobose, mostly 1-seriate, becoming about 3-septate and muriform, 5–8 mic. in diameter, surrounded by numerous spore-like bodies which appear like minute appendages.

On bark of *Fraxinus* and *Gleditschia.*

TYPE LOCALITY: Lincoln, Nebraska.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Nebraska, *Webber* (type).

22. **Thyronectroidea** gen. nov.

Perithecia cespitose in erumpent clusters as in *Thyronectria;* asci clavate-cylindrical, 8-spored; spores elliptical, many-septate, becoming muriform, at first hyaline, becoming dark brown.

Type species: *Thyronectria chrysogramma* Ellis & Everh.

Distinguished from *Thyronectria* by the colored spores.

1. **Thyronectroidea chrysogramma** (Ellis & Everh.)

Thyronectria chrysogramma Ellis & Everh. Proc. Acad. Nat. Sci. Phil. 1890: 245. 1891.

Mattirolia chrysogramma Sacc. Syll. Fung. 9: 993. 1891.

Perithecia springing from below the epidermis in dense cespitose clusters of 3–6 perithecia each; individual perithecia ovate, .25–.5 mm. in diameter, clothed with a greenish-yellow coat with the ostiolum bare and black; asci clavate-cylindrical, 150–175 × 14–18 mic., 8-spored; spores 2-seriate, elliptical, mostly a little

curved, 7–10-septate, with very faint, interrupted, longitudinal septa, at first hyaline, becoming quite dark brown, 25–35 × 10–12 mic.; paraphyses abundant.

On bark of *Ulmus americana.*

TYPE LOCALITY: Manhattan, Kansas.

DISTRIBUTION: Kansas to Ontario and New York.

SPECIMENS EXAMINED: Ohio, *Morgan;* Ontario, Canada, *Dearness.*

NEW YORK BOTANICAL GARDEN.

EXPLANATION OF PLATE XIII.

1. *Megalonectria pseudotrichia* (Schw.) Speg., × 25.
2. *Megalonectria pseudotrichia* (Schw.) Speg., asci and spores, × 400.
3. *Creonectria pithoides* (Ellis & Everh.) Seaver, natural size.
4. *Creonectria pithoides* (Ellis & Everh.) Seaver, × 25.
5. *Creonectria seminicola* Seaver, two thirds natural size.
6. *Creonectria seminicola* Seaver, × 25.
7. *Creonectria seminicola* Seaver, conidiophores, × 400.
8. *Creonectria tuberculariformis* (Rehm) Seaver, natural size.
9. *Creonectria tuberculariformis* (Rehm) Seaver, × 10.
10. *Creonectria tuberculariformis* (Rehm) Seaver, conidiophores, × 400.
11. *Creonectria rubicarpa* (Cooke) Seaver, natural size.
12. *Creonectria rubicarpa* (Cooke) Seaver, × 25.
13. *Scoleconectria canadensis* (Ellis & Everh.) Seaver, × 25.
14. *Scoleconectria canadensis* (Ellis & Everh.) Seaver, asci and spores, × 400.
15. *Echinodothis tuberiformis* (Berk. & Rav.) Atk., × 2.

A NOTABLE SPECIES OF GYMNOSPORANGIUM FROM COLORADO

Frank D. Kern

While collecting fungi in the vicinity of Trinidad, Colorado, on May 20, 1908, the writer came upon a moderate sized tree of *Sabina monosperma,* affected with what appeared to be some small species of *Gymnosporangium.* The sori were just breaking forth between the scale-like leaves (Fig. 1, *a*) in a very inconspicuous manner much after the style of *G. inconspicuum,* a species recently described by the writer and previously collected only in the vicinity of Glenwood Springs on *Sabina utahensis.* So striking, in fact, was the resemblance to *G. inconspicuum* in general appearance and habit, that there was at first examination not the slightest suspicion that it wonld turn out to be another thing. Thinking that the range of a hitherto little known species would be considerably extended, and another host added, it was with especial delight that a collection was made. It was evident that germination had not yet taken place and a small quantity of material was immediately sent in to the laboratory by mail, to be kept fresh by putting the branches in water, with the hope that some cultures might be made.*

After returning to the laboratory several days later, a microscopical examination was made and it was then learned that the supposition entertained in the field was incorrect, and that a new and distinctive species had been discovered.

The spores of the Trinidad specimen are thick-walled, considerably constricted at the septum, rounded both above and below, and have a pedicel of uniform, relatively small diameter, while those of *G. inconspicuum* are thin-walled, not at all or only slightly constricted, narrowed above, and have a carotiform pedicel of considerable thickness just below the spore.

* It may be recorded here that this was subsequently sown upon *Crataegus* and *Amelanchier* without infection. Although the material seemed to be in good condition, no germination of the spores was observed either in drop cultures or in the sori that were employed for the attempted cultures.

It is, however, in the number and location of the germ pores that the new species is especially notable. It has from five to seven large, scattered pores in each cell (Fig. 1, *b*). No other species of *Gymnosporangium* has ever been observed by the writer with more than two germ pores. A number of species have been reputed to have four in each cell,* but on very careful examination the writer has never been able to verify this assertion. Seven seems to be the usual number in the species under

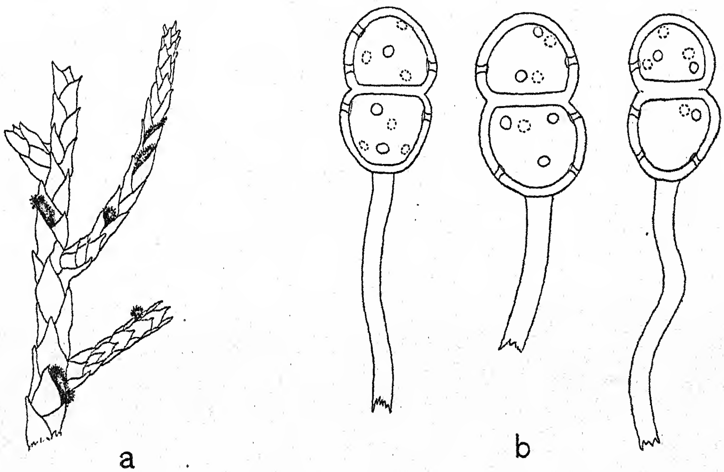


FIG. 2. *a,* Portion of green branch showing manner in which the sori break forth between the scale-like leaves; about three times natural size. *b,* Three teliospores showing outline, uniformly thick walls and size and location of the many pores, × 468.

discussion, although a few were observed where only five or six could be found. The fact that the pores are scattered is also significant. In all other species of the genus they have some definite arrangement, such as, near the septum in both cells, or apical in the upper, and sometimes near the pedicel in the lower cell. It may be further noted here that this character of numerous scattered pores in the teliospores is not only new to the genus *Gymnosporangium* but has never been known in any genus of the family Aecidiaceae, which includes such well-known genera as *Puccinia, Uromyces* and *Phragmidium.*

* See Farlow, Anniv. Mem. Boston Soc. Nat. Hist., The Gymnosporangia or Cedar-apples of the United States, pp. 13, 17, 18, 23. 1880.

The new species may be characterized as follows:

Gymnosporangium multiporum sp. nov.

Teliis inter folia squamosa erumpentibus, irregulariter dispositis, musciformibus, parvis, 0.5–0.8 mm. altis, pallide castaneo-brunneis; teliosporis uniseptatis, ellipsoideis, $20–24\,\mu \times 45–51\,\mu$, apice et basi rotundatis, medio constrictis; episporio cinnamomeo-brunneo, 1.5–2.5 mm. crasso; pedicello hyalino, $7–9\,\mu$ diam., longissimo; poris germinationis 5–7 sparsis instructis.

In ramulis *Sabinae monospermae* (Engelm.) Rydb. (*Juniperi occidentalis monospermae* Engelm.) Trinidad, Colorado, Maio 20, 1908, *Frank D. Kern.*

In addition to the type collection the writer has received a specimen from Prof. E. Bethel on *Sabina utahensis* (Engelm.) Rydb. (*Juniperus californica utahensis* Engelm.), collected at McCoy, Colo., July 16, 1908. These two localities are rather widely separated but may be taken to indicate that the species is distributed all over the southern and southwestern portion of the state. The fact that both *Sabina monosperma* and *S. utahensis* are hosts is an indication of the similarity between these two cedars. *Gymnosporangium speciosum* also occurs on these two hosts and there is every reason to suppose that a parasite inhabiting one may inhabit the other. No clue as to a possible roestelial connection has yet been obtained either for the new species or for *G. speciosum.*

PURDUE UNIVERSITY,
LAFAYETTE, INDIANA.

A NEW POISONOUS MUSHROOM

William A. Murrill

A most interesting case of mushroom poisoning was recently brought to my attention by Dr. W. C. Deming, of Westchester, who poisoned himself and the members of his family with a small mushroom found growing in the grass at Morris Park. This mushroom does not belong to the class usually considered poisonous, and its properties have never before been tested. This is only another argument in favor of not eating mushrooms of any kind unless they are perfectly well known. The chances in this case were about one in a thousand, but Dr. Deming happened to get the one.

On the very day that the poisoning occurred, I had noticed two small mushrooms growing together in quantity on the lawn in front of the museum building of the New York Botanical Garden. These were carefully studied and the accompanying illustration made of them. The two kinds brought in by Dr. Deming from Morris Park proved to be the same that I had collected and studied here.

The non-poisonous kind, *Panaeolus papilionaceus,* is two or three inches high and one-half to three-quarters of an inch broad, with conical cap and perfectly smooth, smoky-brown upper surface, the lower surface being brownish-black and somewhat grayish-speckled. If the cap is removed and placed on a piece of white paper under a tumbler, the spore-print is black.

The poisonous kind, *Inocybe infida,* is slightly larger, with semiorbicular cap surmounted by a prominent nipple, which is dark reddish-brown, while the rest of the upper surface is light tawny-brown. The upper surface also differs from that of the non-poisonous kind in being silky-scaly and shining. The lower surface differs in being much lighter, pale yellowish instead of brownish-black, and the spore-print is about the color of oak wood. Most of these differences may be seen in the illustration.

The fact that Dr. Deming is a practising physician, as well as a student of fungi, makes his observations in this case exceedingly valuable. Replying to a letter requesting detailed information, Dr. Deming wrote me on June 22 as follows:

"I thank you for your letter and the interest you take in the mushroom incident. I was once vice-president of the N. Y. Mycological Club, about the time when Professor Underwood was its president, and so I should have known better than to break my heretofore carefully observed rule not to eat any

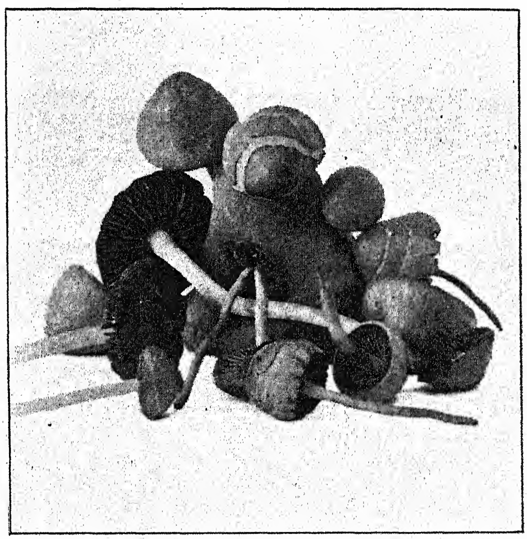


FIG. 3. *Panaeolus papilionaceus* (Bull.).

mushrooms in quantity that I did not know to be perfectly safe. Of the two kinds left with you, the smaller, dark ones I have eaten freely for several years and they are excellent. The other kind I was not familiar with, but it was growing in abundance on the lawn of the Morris Park Club House on June 14.

"I here transcribe notes made on that or the following evening: June 14, '09, about 11:30 A. M., my son and I gathered about a quart of mushrooms, mostly of the unknown variety and some of the variety frequently eaten. No other kind was gathered. These were stewed and served on toast at 1 P. M. I ate only one-half slice with the mushroom thereon, some bread and

butter, two cups of weak tea, a little more than one-half a stuffed egg, with lettuce and mayonnaise dressing.

"Directly after lunch I smoked one half a cigarette as usual. On finishing this, I began to wonder if this or the mushroom had disagreed with me, on account of a slight "queer" feeling which I cannot accurately describe, but it was so little at first that I dismissed it from my mind. In a few minutes, however, I gradually began to get a fullness in the head and a rapid heart action as if I had taken nitroglycerin. Then I began to sweat, with a feeling of heat over the body, so that my clothing was drenched, even my outer clothing requiring changing later. At the same

FIG. 4. *Inocybe infida* (Peck).

time there was no nausea nor prostration nor other bad feeling, and I attended to a man with a wound in my office and then to other members of the family without difficulty, though a little confused in mind perhaps. A little after this, perhaps forty-five minutes after eating the mushrooms, I washed out my stomach with a tube and later took about an ounce of castor oil. Soon after, but long before the oil operated, I had a disagreeable sense of pressure, almost pain, in the lower bowel, accompanied for a little while by slight abdominal soreness or pain. All symptoms gradually subsided and by evening I was as well as ever except for a little feeling of exhaustion.

"My wife, 25 years old, ate one whole slice of toast with mushrooms, two half eggs stuffed, with lettuce and mayonnaise, tea, bread and butter. About half an hour later she felt nauseated and dizzy and lay down. I gave her five glasses of warm water, after which she vomited the egg, but saw no mushrooms. She then took castor oil.

"Mrs. A., 65 years old, ate the same amount of mushrooms, several slices of bread and butter, a cup of tea, but no eggs nor salad. When asked, said she felt slight indigestion, but otherwise well.

"My son, 5 years old, ate same amount, but no eggs nor salad. Immediately after lunch he had a diarrheal movement containing mushrooms. He was given ipecac and warm water and vomited some mushrooms.

"Sophie, maid, aged 30, tasted mushrooms. Felt nauseated soon after. Given mustard and water, but did not vomit. Later, castor oil and was purged and somewhat prostrated. Hattie, maid, aged 38, tasted mushrooms. Belched gas soon after. Not sick. Esther, maid, aged 24, tasted; no effects.

"There was no peculiar taste to the cooked mushrooms, perhaps a very evanescent bitterness in the raw state. I thought perhaps the combination of the eggs and mayonnaise with the mushrooms had something to do with the effects, as my wife and I, the only ones who ate both in any amount, were the chief sufferers. In my case the beating of the heart, full head and sweating were very marked, though I ate but half as much as the others."

It is impossible to tell until a chemical analysis is made just what poison this mushroom contains. It is probably not narcotic, as in the case of the deadly amanita, since the effects appear too quickly. On the other hand, there is nothing in the taste of the mushroom, according to my own experiments with fresh specimens, to suggest an irritating poison. It is altogether likely that this species, belonging as it does to a group quite different from any heretofore recognized as containing poisonous species, will be found to contain a new poison with effects heretofore undescribed.

NEW YORK BOTANICAL GARDEN.

A SPECIES OF DISCOSIA ON LIVING BULL PINE SEEDLINGS

F. D. Heald

(With Plate 14, Containing 7 Figures)

A dozen or more species of *Discosia* are recorded by Saccardo from various parts of the United States. The species of this genus have been found upon the leaves of various herbaceous plants and upon the leaves of deciduous trees. In all cases, they were on languid, dead, dry, or decomposing remains of the host plant. One species has been described from the samaras of *Fraxinus americana*. Two species of the genus have been described from specimens found on coniferous hosts: *Discosia virginiana* Thüm.* on the dead leaves and branches of *Juniperus virginiana,* from Newfield, N. J., and *Discosia strobilina* Lib. on the fallen cones of a species of *Abies* from Arduennis.†

During an examination of the Forest Reserve at Halsey, Nebr., May 17, 1907, in an effort to determine the cause of a troublesome blight of the young pine seedlings, my attention was called by Mr. W. F. Mast to the fungus here described. The species, which is apparently a new one, was found growing upon the *living seedlings* of the bull pine (*Pinus ponderosa*). It has not been determined whether this fungus is in any way connected with the blight that was prevalent. In all cases where the fruiting fungus was found on the seedlings, they did not show any signs of injury, but were apparently in *vigorous condition.*

The seedlings which showed the fruits of the fungus were in the year old beds. The pycnidia are scattered along the hypocotyl slightly above the ground line, and show as minute coal-black specks, easily visible to the naked eye (Fig. 1). The following measurements will give their variation in size: (1), $164 \times 310.5\,\mu$; (2), $155 \times 241.5\,\mu$; (3), $121 \times 241.5\,\mu$; (4), $138 \times 362\,\mu$; (5), $121 \times 224\,\mu$.

* Saccardo, Syll. Fung. 10: 427. 1892.

† Saccardo, Syll. Fung. 3: 656. 1884.

The pycnidia vary in form; the majority are oblong or elliptical, while some are lobed or notched. In all a central ostiole is present (Figs. 2, 3).

The spores are three-septate and either clear or slightly smoky, and each terminal cell bears a straight or slightly curved cilium a little longer than half the length of the spore. In many of the spores the two terminal cells are quite clear, and less granular than the two middle cells. The spores are comparatively uniform in diameter, and nearly straight, with a slight curvature on the side directed away from the cilia. The length varies from 12 to 20 μ but the diameter shows no appreciable variation, never exceeding 2.6 μ (Figs. 4, 5). The detail of the spore formation as represented in cross-sections of the pycnidia shows the spore-bearing branches as straight, unbranched hyphae with spores erect and packed closely together (Fig. 6).

The parenchymatous condition of the pycnidium wall is very apparent in the basal portion but less so in the superficial portion. A characteristic and well-marked feature of the pycnidium is the occurrence of vertical supporting columns of hyaline hyphae which run from the floor of the pycnidium to the roof, and serve to retain the wall of the pycnidium in its original position until the spores have escaped (Fig. 7).

The following technical description of this fungus is appended:

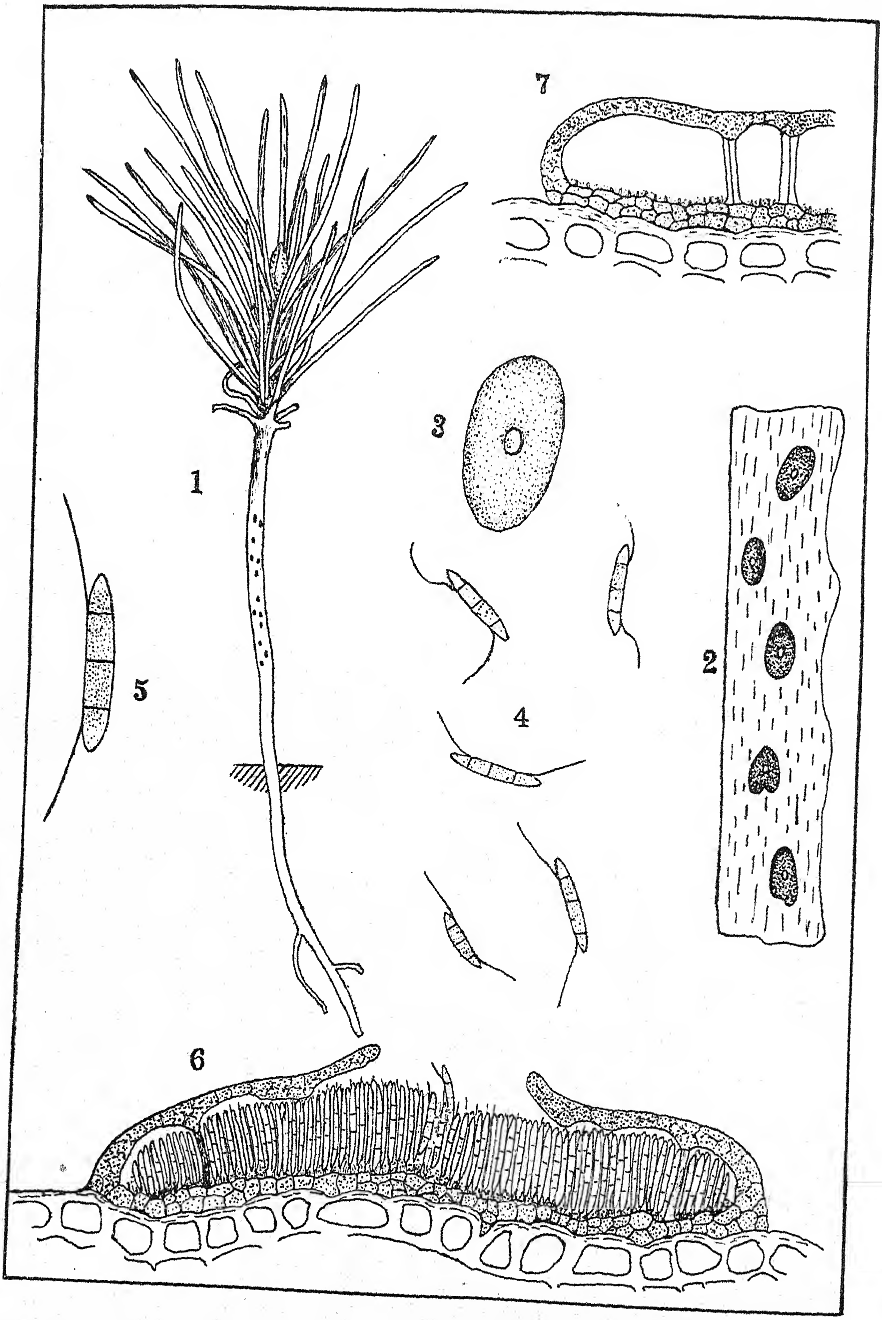
Discosia Pini sp. nov.

Peritheciis sparcis vel subgregariis, superficialibus, applanatis, nigris, opacis, glabris, ostiolo subpertusis; ellipticis vel leniter lobulatis, 225–362 μ = 120–165 μ; sporulis oblongo-fusiformis, 3-septatis, hyalinis vel leniter fumagineis, 12–20 = 2.6 μ, 2-ciliatis, 10–12 μ longis (*pl. 14, f. 1–7*).

Ad hypocotylem viventem *Pini ponderosae,* Forest Reserve, Halsey, Nebraska.

Type specimen, No. 758, Herb. Dept. Agric. Bot., Univ. of Nebraska, Lincoln, Nebraska.

DEPARTMENT OF BOTANY,
UNIVERSITY OF TEXAS.



DISCOSIA PINI HEALD

EXPLANATION OF PLATE XIV.

FIG. 1. One year old seedling of *Pinus ponderosa,* showing pycnidia on the hypocotyl. Natural size.

FIG. 2. Pycnidia showing variation in form.

FIG. 3. Single pycnidium showing the typical elliptical form and central ostiole.

FIG. 4. Group of spores, showing form, septation, and number of cilia.

FIG. 5. Single spore, much enlarged, showing insertion of the cilia.

FIG. 6. Complete cross-section of pycnidium, showing position and arrangement of the spores, character of pycnidium wall, and slightly protruding lips of the ostiole.

FIG. 7. Portion of cross-section of a pycnidium with spores removed to show two of the vertical supporting pillars or columns.

NOTEWORTHY ADDITIONS TO THE MYCOLOGICAL HERBARIUM

Four Interesting Species of Moulds

In the study of moulds at the New York Botanical Garden during the month of July, 1909, the following interesting species were found and placed in the herbarium.

Mucor rufescens Fischer. This species was found in considerable quantity on elephant's dung. It is very distinct and easily recognized by the flaccid sporangiophores forming a network over the substratum, and by the orange-colored substance in the columella and upper part of the sporangiophore.

Mucor circinelloides van Tieghem. This species is very variable in its mode of branching, but the circinellate branches are usually evident. It was cultivated on bread.

Pilobolus longipes van Tieghem. The elongated, worm-like swelling at the base of the sporangiophore is very characteristic of this species. Found on horse dung.

Circinella umbellata van Tieghem & Le Monnier. This beautiful species is generally found with *Thamnidium elegans* Link. It was collected on dung of jaguar.

David R. Sumstine.

A New Boletus from Tropical America

Boleti are exceedingly scarce in tropical America, and, indeed, in all tropical countries. This is true also of certain genera of large, fleshy agarics, such as *Russula* and *Lactaria*. The extremes of moisture and dryness may be too great for these plants, which are essentially terrestrial, as opposed to many tropical forms of agarics that occur on dead wood; they may lack the association and substratum connected with certain trees of temperate regions, such as oaks and chestnuts; they may have been partially or totally cut off from these regions by certain barriers in the course of geographical distribution; or they may be temperate

species, unadapted to tropical conditions generally, as is the case with many of our common higher plants.

The first boletus reported from tropical America was collected by Oersted in volcanic soil on the Irasi volcano, Costa Rica, and described by Fries in 1851 as *Boletus robustus.* In 1868, two species, *B. cubensis* and *B. lignatilis,* were described by Berkeley from the collections of Wright in Cuba. In 1900, Patouillard described *B. guadalupensis* from specimens collected by Père Duss in Guadeloupe. During the past winter I found *Rostkovites granulatus* quite common at Cinchona, Jamaica; and two collections of *Ceriomyces communis* have recently been sent in from the Bahamas. A new species, collected in Costa Rica by Mr. Maxon, may be characterized as follows:

Ceriomyces Maxoni sp. nov.

Pileus irregularly circular in outline, convex, slightly depressed, 7 cm. broad, 1–1.5 cm. thick; surface glabrous, smooth, very dark brown, almost black near the margin, slightly lighter at the center with dark blotches, margin undulate, involute: context very fleshy; hymenium strongly concave, pure creamy white, tubes adnate, rather short, small, angular, thin-walled, edges becoming lacerate: spores oblong-ellipsoid, smooth, hyaline, 2-guttulate, $9–11 \times 3–4\,\mu$: stipe central, thick, tapering downward, 2.5 cm. long, 3 cm. thick at the apex, 1.5 cm. thick at the base, smooth and glabrous below, closely and conspicuously reticulate above, fleshy, solid.

Type collected near Coliblanco, on the slopes of the volcano Turrialba, Costa Rica, at approximately 2,000 meters, among mosses on a rotten log in a clearing in the forest, May 1, 1906, *W. R. Maxon 301.*

W. A. MURRILL.

NEWS AND NOTES

Miss M. F. Barrett spent the month of July at the Garden studying the collections of gelatinous fungi.

Mr. H. S. Jackson has been appointed plant pathologist of the agricultural experiment station at Corvallis, Oregon.

Joseph E. Kirkwood, Ph.D., Columbia, 1903, has been appointed assistant professor of forestry and botany in the University of Montana. He was formerly professor of botany in Syracuse University and for a time a botanical investigator for the Continental-Mexican Rubber Company.

Mr. William T. Horne, who was fellow in botany in Columbia University in 1903–'04, has resigned his position as chief of the department of plant pathology of the Cuban Agricultural Experiment Station and has accepted an appointment as assistant professor of plant pathology in the University of California.

Tropical Life announces a prize of fifty pounds sterling for an essay embodying research work directed towards ascertaining exactly what changes (together with their causes and whether these changes occur during the fermentation process only or while being dried) take place in the cacao bean between the time that it leaves the pod until it is shoveled into the bag for export. For further information those interested may address the editor of *Tropical Life,* 112 Fenchurch St., E. C. London.

Preliminary notes on the genus *Usnea,* as represented in New England, by R. Heber Howe, Jr., appeared in the Torrey Bulletin for June, 1909. The article contains a key to the species and copious notes on their appearance and distribution, accompanied by three plates of illustrations.

Professor John Dearness, of London, Canada, has been spending the summer at Truro, Nova Scotia, engaged in making a collection of fungi.

Dr. C. H. Peck describes twenty-two new species of fungi, mostly agarics, in the June number of the Torrey Bulletin. More than half of these were collected by Professor C. F. Baker at Claremont, California.

The first number of the new botanical journal *Dörfleria,* published by Dörfler in Vienna, appeared in May, 1909, and was widely distributed among botanists. This journal is intended to be an international organ supplying a botanical biblography and reporting upon everything that happens in the botanical world.

Dr. W. A. Murrill, Assistant Director, visited Mountain Lake, Virginia, in July and obtained nearly a thousand specimens of fungi, mostly large fleshy species. This region is moist and heavily wooded, the elevation being over four thousand feet, and its fungous flora has been up to this time practically unknown, although by inference closely related to that of the high mountains of West Virginia and North Carolina.

An exceedingly useful pamphlet on the Diseases of Deciduous Forest Trees, embodying the results of many years of observation and experiment, was issued in June, 1909, as Bulletin No. 149 of the Bureau of Plant Industry, U. S. Department of Agriculture, under the joint authorship of Hermann von Schrenk and Perley Spaulding. This bulletin contains 66 pages of text, a bibliography of 114 citations, and 10 excellent half-tone plates. The more important diseases of deciduous forest trees are here discussed, leaving those peculiar to shade and ornamental trees for another publication.

Dr. Peck's report for 1908, issued in July, 1909, as Museum Bulletin 131, is a volume of 202 pages and 4 colored plates, containing, besides the usual reports on additions to the herbarium, a monographic treatment of the New York species of *Lentinus*

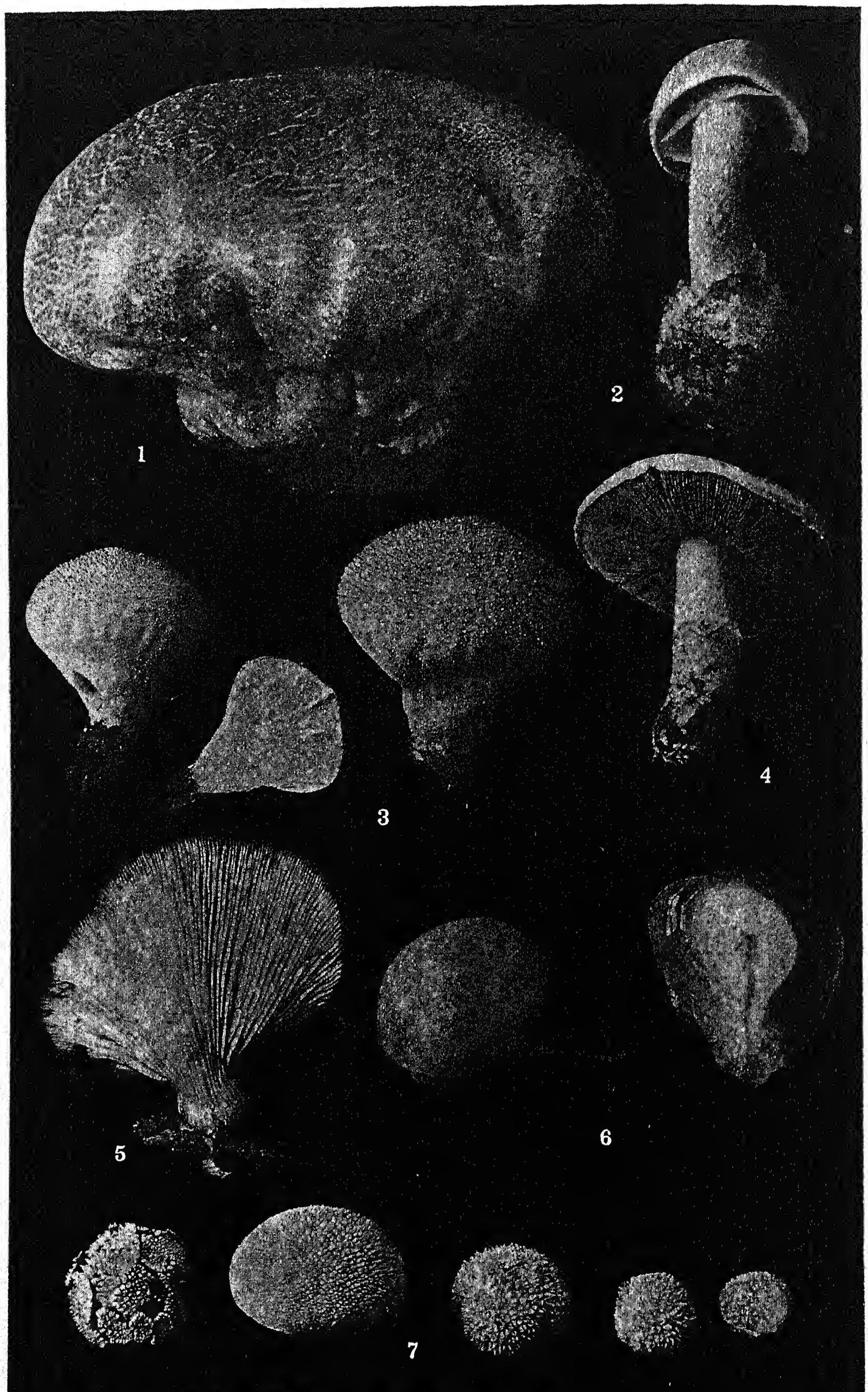
and *Entoloma* and a list of species and varieties of fungi described by Dr. Peck during forty years of remarkable activity. The number of new species of fungi, exclusive of the new varieties, described by him during this period reaches a total of nearly two thousand five hundred. Dr. Peck has, practically speaking, collected his own mycological herbarium and written his own mycological library.

An important pamphlet on Bud Rot and Some Other Cocoanut Troubles in Cuba, by William Titus Horne, was recently issued as Bulletin No. 15 of the Cuban Experiment Station, Santiago de las Vegas. The bud rot has been known in the West Indies for a number of years, where it constitutes the most serious obstacle to the cultivation of the cocoanut. It causes the nuts to drop, the leaves to turn yellow, and the bud, or heart, of the tree to decay. The cause of the disease is still unknown, but it is believed to be bacterial in nature, and there is abundant evidence that healthy trees are infected from diseased ones.

A satisfactory treatment for this disease has not yet been discovered, but it may be held in check by the destruction of the tops of all trees dead or seriously affected with bud rot; by flaming, or burning out the tops, of all early cases, or trees suspected to have the disease; and by spraying with Bordeaux mixture in the hope of curing early cases and for the protection of healthy trees. All three methods have been employed in Jamacia with good results.

A valuable descriptive paper by T. Petch on the Phalloideae of Ceylon, accompanied by eleven handsome plates, appeared in the December number of the Annals of the Royal Botanic Gardens, Peradeniya. Five Ceylon species were collected by Gardner in 1844, and Berkeley described an additional species from Thwaites' collections in 1863–68. To these, Massee later added *Phallus proximus,* and two other species have since been described. The number of species is still considerably behind that of Java, but it may be materially increased when the lower elevations are explored. The species already known exhibit a marked distribution according to altitude.

Mr. Petch is engaged in the very important task of redescribing the fungi of Ceylon, and he has met with many difficulties in his work because of the different sets of types and the inadequate descriptions based on them. He is of the opinion "that the only possible way in which any definite knowledge can be evolved out of the present chaos is that mycologists of each tropical country should work out their species in a similar manner (by comparison with types), and that when this is done they should interchange specimens and colored drawings of at any rate their common forms. But if the original collections were not returned to the sender there is no possibility of ever arriving at a definite conclusion, and the existing records are merely so much waste paper. Certainly the present practice of consigning Basidiomycetae to Europe is a waste of time. The describers not only fail to recognize a species: in many cases they do not hit upon the right genus. The descriptions are unrecognizable, and the 'species' upon which they are founded are often only damaged or abnormal forms of common things. The latter is especially the case when, as so often happens at the present day, the actual collecting is entrusted to coolies. *The mycologist must collect his own specimens and know them under all conditions.*"



ILLUSTRATIONS OF FUNGI

MYCOLOGIA

VOL. I NOVEMBER, 1909 No. 6

CULTURES OF UREDINEAE IN 1908[1]

J. C. ARTHUR

The present article forms the ninth of a series of reports[2] by the author upon the culture of plant rusts, covering the years from 1899 to the close of 1908. The grass and cedar rusts have been especially prominent in the years' work. Very considerable advance has been made in segregating the subepidermal rusts on grasses that have generally passed under the name of *Puccinia rubigo-vera,* and some particularly notable results were achieved with forms of *Gymnosporangium,* partly in finding unexpected aecial connections for well-known telial species, and partly in segregating species heretofore confused under European names.

This year for the first time since the series of cultures was begun, the Indiana Experiment Station at Purdue University, where all the study has been conducted, assumed the full expense of the work. Heretofore the extra assistance needed during the chief cultural period of about six weeks has been paid for in part or wholly from outside sources. This year the cultural work was made a part of an extended investigation of cereal and other rusts to be conducted by the station, and the expenses met from the Adams fund, derived from the general government. The more definite and certain financial support has made it possible to better systematize and conduct the work.

As in the previous year some collecting trips made expressly

[1] Read before the Botanical Society of America at the Baltimore meeting, December 31, 1908.

[2] See Bot. Gaz. 29: 268–276, 35: 10–23; Jour. Myc. 8: 51–56, 10: 8–21, 11: 50–67, 12: 11–27, 13: 189–205, and 14: 7–26.

[MYCOLOGIA for September, 1909 (1: 177–224), was issued 11 Sep. 1909.]

to secure culture material proved helpful to an extent far beyond the proportional amount of time consumed. The earliest one took Mr. F. D. Kern and the writer to Mammoth Cave in Kentucky. It was specifically undertaken to discover a telial form to accompany the aecia known to occur on *Porteranthus stipulatus* (*Gillenia stipulacea*). A careful microscopic examination made during the winter of 1907–8 of the aecia on this host, which were collected by Rev. C. H. Demetrio in 1884 at Perryville, Mo., and distributed as No. 3323 in Rabenhorst-Winter, Fungi europaei, under the name of *Roestelia lacerata,* which it much resembles, showed that the fungus was undoubtedly a true *Roestelia,* although the host is an herb belonging to the rose family. As this is the only known instance of the aecial stage of a *Gymnosporangium* occurring on any host outside of the woody plants of the apple family, the detection of the telial form appeared to be a matter of more than usual interest. The original collection was apparently the only one known, until a search was made through the phanerogamic herbaria in a number of places, and a few pycnia were detected on a collection of the host at the New York Botanical Garden, which was made at Mammoth Cave, in June, 1870, by Dr. T. F. Allen. Upon writing to Rev. Demetrio it was learned that the locality of the original collection has been turned into cultivated fields, quite destroying the chances of making a second collection in the original habitat. It was known to the writer that the estate of several thousand acres about the Mammoth Cave has been in litigation for a number of years, and that few changes have taken place in the long period during which the cave has been an object of world-wide interest to tourists. After considering these facts it was decided to visit the vicinity of the cave, hoping to detect material from which cultures could be made. Two days were spent at the cave. The most careful search on the first day was in vain, although the host was found as tender shoots only a few inches high, and also an abundance of red cedar trees. The second day afforded better success, and considerable material of what appeared to be a new form of *Gymnosporangium* was discovered on the trunks of small cedars growing near plants of *Porteranthus,* although pycnia and aecia could not be expected owing to the earliness of the season. Sub-

sequent cultures confirmed the inferences from field observation, and abundantly justified the method pursued in this case in tracing the life history of a little or imperfectly known rust.

The next important excursion to points outside of the state of Indiana was made by my associate, Mr. F. D. Kern, the writer's ill health preventing further active participation in securing material for the work of the season. Mr. Kern reached Denver, Colo., on May 16, and spent five days collecting material and making field observations chiefly along the foot hills from Boulder on the north to Trinidad on the south. During this time he had the invaluable assistance of Mr. E. Bethel, the able mycologist of Denver, who supplied important information about suitable localities to visit, and for part of the time himself went along to help in every way possible. The results fully justified the time and outlay, especially in the way of knowledge regarding the numerous and intricate forms of cedar rusts. The telia of the true *Roestelia cornuta* were collected on this trip for the first time in America. The telia of the true *R. penicillata,* little known in America, were also taken, but owing to misfortune in manipulation did not lead to successful cultures.

On his return journey from Colorado Mr. Kern made a detour to Racine, Wis., where as the guest of Dr. J. J. Davis he visited in an automobile the Wind Lake locality, made familiar to mycologists by Dr. Davis' numerous collections and observations. Here material was obtained of the juniper rust, believed to be associated with the *cornuta*-like aecia on *Aronia*. It had been sent by Dr. Davis for cultures in previous years, but had not been brought to germination. This is the type locality for the species, to which Mr. Kern has given the name *Gymnosporangium Davisii.*[3]

At our request Mr. H. S. Jackson, of Newark, Del., made some fruitful collecting tours for observations on the Atlantic coast rusts. A two days' trip to Seaford and Lewes, Del., was made the middle of November, 1907, and again to the same places the latter part of April following. The duplicate trip was especially designed to secure observations on the early appearance of aecia in the immediate vicinity where telial culture material had pre-

[3] Bull. Torrey Club 35: 507. 1908.

viously been taken. Mr. Jackson proved a keen observer, detecting a new species on *Carex comosa* with its probable aecia on *Smilax,* and both aecia and telia of *Puccinia subnitens,* the first collection of it made on the Atlantic coast, beside much other serviceable information. He also made a trip to Newfield, N. J., on May 15, and secured telial material of cedar rusts from the region made familiar by the late Mr. J. B. Ellis.

The season's cultural work was, with the exception of some cedar rust cultures made by Mr. Kern, in the hands of Mr. A. G. Johnson, a graduate of the South Dakota Agricultural College, and a former special student of Washington University, St. Louis, who was recommended for the position by Dr. E. W. Olive. He was diligent and enthusiastic in the work, and made successful cultures of the largest number of species secured in any one season during the ten years that the cultural work has been in progress.

In this series of studies the amplitude of the results is largely dependent upon the kindly assistance of correspondents in providing culture material and in communicating field observations. Acknowledgments are due this year to Mr. E. Bethel, Denver, Colo., who is far in the lead with more than fifty collections of culture material, and to Messrs. H. S. Jackson, Newark, Del., J. M. Bates, Red Cloud, Neb., R. E. Stone, Auburn, Ala., A. O. Garrett, Salt Lake City, Utah, Elam Bartholomew, Stockton, Kans., E. W. Olive, Brookings, S. D., E. W. D. Holway, Minneapolis, Minn., H. J. Webber, Ithaca, N. Y., T. D. A. Cockerell, Boulder, Colo., J. L. Sheldon, Morgantown, W. Va., A. B. Seymour, Cambridge, Mass., G. P. Clinton, New Haven, Conn., P. B. Kennedy, Reno, Nev., Guy West Wilson, Fayette, Iowa, George L. Potter, Lima, Ind., J. J. Davis, Racine, Wis., A. R. Sweetser, Eugene, Ore., C. W. Edgerton, Donald Reddick and C. J. Humphrey, all three of Ithaca, N. Y., W. A. Kellerman, at the time in Guatemala, C. G. Lloyd, Zacatecas, Mex., and J. Dearness, London, Ont. This enumeration gives scanty credit where in many cases special trips, often of many miles, were undertaken at our request to secure at a definite time either dry material or live hosts, or to make observations, which would further a particular inquiry. Mention should also be made of

the assistance rendered by Dr. Wm. Trelease, of the Missouri Botanical Garden, St. Louis, Mo., who sent plants of *Porteranthus stipulatus* on which the new cedar rust was sown. The writer extends his warmest thanks to the above individuals and to others who have assisted in the year's investigations.

During the present season 204 collections of material with resting spores and 26 collections with active spores were employed, from which 565 drop cultures were made to test the germinating condition of the spores. Out of the 204 collections with resting spores 99 could not be brought to germination although seemingly in perfect condition leaving 105 collections of available material. These 105 collections with resting spores and 26 with active spores belonged to about 60 species of rusts. Altogether 321 sowings were made, employing for the purpose 114 species of hosts, these being grown in pots, so that the work of attempted infection could be conducted wholly in the greenhouse.

The results of this work are given in the following paragraphs, and are divided into negative results, positive results with species whose life cycles have already been ascertained by the writer or other investigators, and positive results with species whose life cycles are now first placed on record.

NEGATIVE RESULTS:—Quite a number of collections gave good germination of the spores, but no infections were secured. The following may be recorded to serve for reference in future studies:

1. PUCCINIA on *Carex pennsylvanica* L., collected at Red Cloud, Neb., by Rev. J. M. Bates, was sown on *Arabis Holboellii*, with no infection. Similar material was sown in previous seasons on thirty-eight other species of hosts.[4]

2. PUCCINIA VULPINOIDIS Diet. & Holw., on *Carex vulpinoidea* Michx., collected at Newark, Del., by Mr. H. S. Jackson, was sown on *Viola cucullata, Chelone glabra, Aster paniculatus, Ambrosia trifida, Cacalia reniformis, Laciniaria punctata, Rudbeckia laciniata* and *Senecio obovatus*. A similar collection made at London, Ontario, by Mr. J. Dearness, was sown on *Callirrhoe involucrata* and *Rudbeckia laciniata*. Still a third collection made

[4] See Jour. Myc. 10: 10. 1904; 11: 51. 1905; 12: 12. 1906; 13: 191. 1907; and 14: 9. 1908.

by the writer at Lima, Ind., was sown on *Napaea dioica, Ambrosia trifida, Aster Drummondii, Boltonia asteroides, Cacalia reniformis, Laciniaria spicata, Rudbeckia laciniata* and *Senecio obovatus.* None of the trials resulted in infection.

3. PUCCINIA on *Carex gravida* Bailey, sent by Rev. J. M. Bates from Red Cloud, Neb., was sown on *Abronia umbellata, Vernonia arkansana,* and twice on *Artemisia dracunculoides,* with no infection. Similar material from the same region has been sown in previous years upon forty-four other species of hosts with negative results.[5]

4. PUCCINIA on *Carex* sp., sent by Mr. C. W. Edgerton from Ithaca, N. Y., was sown on *Iris versicolor* twice, with no infection. This was the culmination of a series of observations to ascertain the telial form belonging to aecia on *Iris,* which had been noticed for a number of seasons in one locality near the town of Ithaca. Four collections taken from the close vicinity of the rusted *Iris* were sent for trial in 1907, two of which grew well on *Aster paniculatus,* but not on *Iris,* while the other two failed to germinate. All four of these collections agreed morphologically with *Puccinia Caricis-Asteris* Arth. In continuation of the search for the true alternate form for the *Iris* rust, Mr. Edgerton sent this season from practically the same spot a rust on an undetermined *Carex,* having morphological characters quite unlike those of *P. Caricis-Asteris,* and approximating, if not identical with, *P. quadriporula* Arth. As no positive results were obtained from this material the identity of the alternate form of the aecial rust on *Iris* still remains in doubt.

5. PUCCINIA DULICHII Syd., on *Dulichium arundinaceum* (L.) Britt., collected at Seaford, Del., by Mr. H. S. Jackson, was sown on *Decodon verticillatus, Smilax hispida, Lysimachia quadrifolia* and *Senecio obovatus,* with no infection.

6. PUCCINIA EMACULATA Schw., on *Panicum capillare* L., collected at Fayette, Iowa, by Prof. Guy West Wilson, was sown on *Macrocalyx Nyctelea, Hydrophyllum virginicum, Amorpha fruticosa,* and *Napaea dioica,* with no infection. Similar material was sown in previous seasons on twenty-three other species of hosts.[6]

[5] See Jour. Myc. 10: 10. 1904; 11: 51. 1905; 12: 12. 1906; 13: 191. 1907; and 14: 10. 1908.

7. PUCCINIA SCHEDONNARDI K. & S., on *Schedonnardus paniculatus* (Nutt.) Trel., collected at Boulder, Colo., by Mr. E. Bethel, was sown on *Thalictrum polygamum* and *Grindelia squarrosa,* with no infection. Like material was sown in previous seasons on eighteen other species of hosts.[7]

8. PUCCINIA ELLISIANA Thüm., on *Andropogon scoparius* Michx., collected at Newark, Del., by Mr. H. S. Jackson, was sown on *Actaea alba, Ambrosia trifida, Anemone virginiana, Dirca palustris, Hydrophyllum virginicum, Ipomoea pandurata, Isopyrum biternatum, Iva frutescens, Pentstemon hirsutus, Phacelia bipinnatifida, Psoralea Onobrychis* and *Verbena urticifolia,* with no infection. Similar material from Colorado was sown the previous year on ten other species of hosts.[8]

9. PUCCINIA VEXANS Farl., on *Atheropogon curtipendulus* (Michx.) Fourn. (*Bouteloua racemosa* Lag.), collected at Stockton, Kans., by Mr. E. Bartholomew, was sown on *Apocynum cannabinum, Caulophyllum thalictroides, Dalea laxiflora, Delphinium tricorne, Hydrophyllum virginicum, Napaea dioica, Polemonium reptans, Symphoricarpos racemosus, Smilax hispida* and *Thalictrum dioicum,* with no infection. This is the first time that an attempt at infection with teliospores has been made, although the amphispores were successfully grown on the same grass host last year.

10. PUCCINIA POCULIFORMIS (Jacq.) Wettst., on *Phleum pratense* L., collected at Sayre, N. Y., by Prof. H. J. Webber, was sown May 1 on *Berberis vulgaris.* Another collection of the rust from Ithaca, N. Y., sent by Mr. Donald Reddick, was sown May 6 on five plants of *Berberis vulgaris,* and once more on May 13. As no infection showed after the usual interval, the same material was again sown May 22 on three plants of the barberry, and for three successive nights after sowing the inoculated plants were placed in an ice box at a temperature of 10° C. in order to insure more favorable conditions for the penetration of the germ tubes into the tissues of the host. Again on May 28

[6] See Bot. Gaz. 35: 12. 1903; Jour. Myc. 8: 52. 1902; 10: 10. 1904; 12: 12. 1906; 13: 192. 1907; and 14: 11. 1908.

[7] See Bot. Gaz. 35: 11. 1903; Jour. Myc. 13: 192. 1907; and 14: 11. 1908.

[8] See Jour. Myc. 14: 10. 1908.

the same material was sown on *Mahonia Aquifolium*. In each instance the ready germination of the teliospores was established by a drop culture within twenty-four hours preceding the time of sowing, as is done for all the culture work reported in this and preceding years. In no case was an infection secured.

The reasons for believing that this rust should be referred to *Puccinia poculiformis*, in spite of the failure to produce aecia on *Berberis* or *Mahonia*, have been briefly stated by Mr. Frank D. Kern,[9] who has also recorded the history of the appearance of the rust in North America, and it is only necessary that the writer affirm his agreement with Mr. Kern's conclusions.

11. PUCCINIA ASTERIS Duby, on *Aster arenarioides* D. C. Eaton, sent from Salt Lake City, Utah, by Mr. A. O. Garrett, was sown on *Aster Drummondii, A. paniculatus, A. multiflorus* and *Callistephus hortensis*, with no infection. This adds little to the solution of the problem whether the leptopuccinial rust on various species of *Aster* in the different sections of the country are all referable to one species or not.

12. UROMYCES GRAMINICOLA Burr., on *Panicum virgatum* L., collected at Stockton, Kans., by Mr. E. Bartholomew, was sown on *Althaea rosea, Apios tuberosa, Cacalia reniformis, Callirrhoe involucrata, Decodon verticillatus, Hibiscus militaris, Napaea dioica* and *Viola cucullata*, with no infection.

13. UROMYCES ANDROPOGONIS Tracy, on *Andropogon glomeratus* (Walt.) B.S.P., collected at Lewes, Del., by Mr. H. S. Jackson, was sown on *Viola cucullata*, while a similar collection on the same species of host, sent from Auburn, Ala., by Mr. R. E. Stone, was sown twice on *Viola cucullata*, and also on *Comandra umbellata, Dasystoma flava* and *Pentstemon hirsutus*, all with no infection. From the field observations reported by Dr. John L. Sheldon it seems almost certain that the aecia of this rust occur upon *Viola*, and the repeated failure of the cultures may have been due to the maturity of the *Viola* leaves on which the sowings were made.

SUCCESSFUL CULTURES SUPPLEMENTING PREVIOUS WORK:—The following species of rusts were successfully grown, and the facts supplement what have been obtained from previous cultures

[9] Kern. The Rust of Timothy. Torreya 9: 3–5. 1909.

in this series or have been recorded by other American or European investigators. In a number of cases the previous definite knowledge of the species has been materially extended.

1. PUCCINIA KUHNIAE Schw., on *Kuhnia Hitchcockii* A. Nelson, collected at Marshall, Colo., Feb. 22, 1908, by Mr. E. Bethel, was sown May 14, on *Kuhnia eupatorioides.* Numerous pycnia appeared May 24, duly followed by abundant uredinia June 4, and telia June 29. This result confirms the work in 1905,[10] and shows that in all probability all collections of rust on this genus of hosts are referable to the one autoecious species.

2. PUCCINIA PECKII (DeT.) Kellerm., on *Carex stipata* Muhl., collected Oct. 23, 1907, at Lima., Ind., by Mr. George L. Potter, was sown on *Onagra biennis* (L.) Scop., April 28, and gave pycnia May 9 and aecia May 18, both in great abundance.[11]

3. PUCCINIA SAMBUCI (Schw.) Arth., on *Carex lurida* Wahl., collected at Lagrange, Ind., by the writer, was sown on *Sambucus canadensis* L. May 15, and gave a great abundance of pycnia May 23, and aecia June 1.[12]

4. PUCCINIA CARICIS-SOLIDAGINIS Arth., on *Carex sparganioides* Muhl., collected at Lima, Ind., and again at Lagrange, Ind., both by the writer, was sown from the first named locality April 11 on *Aster Drummondii,* giving no infection and again May 4 on *Solidago canadensis* L., giving abundant infection with pycnia showing May 12, and aecia May 19. From the second locality sowings were made April 15 on *Aster paniculatus* and *Solidago canadensis,* giving no infection on the first host, but abundant infection on the second, showing pycnia April 23, and aecia May 5.[13] This result duplicates that obtained in 1905.

5. PUCCINIA ELEOCHARIDIS Arth., on *Eleocharis palustris* (L.) R. & S., obtained at Lima, Ind., by the writer, was sown on *Eupatorium perfoliatum* L., May 13, giving rise to pycnia May 22,

[10] Jour. Myc. 12: 23. 1906.

[11] For previous cultures see Bot. Gaz. 35: 13. 1903; Jour. Myc. 8: 55. 1902; 11: 58. 1905; 12: 15. 1906; and 13: 195. 1907.

[12] For previous cultures see Bot. Gaz. 35: 14. 1903; Jour. Myc. 8: 55. 1902; 12: 14. 1906; and 13: 195. 1907.

[13] For previous cultures see Bot. Gaz. 35: 21. 1903; and Jour. Myc. 12: 15. 1906.

and aecia June 2, both in abundance, thus confirming the work of 1905 and 1906.[14]

6. PUCCINIA ANGUSTATA Peck, on what was probably *Scirpus cyperinus* (L.) Kunth, the plant showing only leaves but growing with plants with fruit, gathered at Spirit Lake, Iowa, by the writer, was sown April 13 on *Lycopus communis* Bickn., giving rise to pycnia April 25, and aecia May 3, both in abundance. It was sown again May 2 on *Lycopus americanus* Muhl., giving rise to an equal abundance of pycnia May 11, and of aecia May 19, the interval between the appearance of pycnia and aecia being exactly the same as in the first culture.[15] The result is interesting in connection with an observation made by the writer while on an excursion in the vicinity of Ithaca, N. Y., June 30, 1906. An abundance of rusted *Lycopus communis* was gathered, with uredinia appearing on close-by plants of *Scirpus cyperinus,* while plants of *L. americanus* and *S. atrovirens* growing intermixed were both quite free from rust. The field observation seemed to indicate a biological difference between the rust occurring on the two species of *Scirpus* and the associated *Lycopus,* and with a view to experimental tests healthy plants of *L. communis* from the Ithaca locality were sent to the greenhouse at Lafayette, the species not occurring in Indiana or Iowa. These were the plants used in the present cultures. The results seem to warrant the tentative conclusion that P. *angustata* within some geographical areas is inclined to form races confined to certain hosts, while in other geographical areas the differentiation into races does not occur, a condition that appears to arise in other species as well, *e. g., Puccinia subnitens* Diet.

7. PUCCINIA SUBNITENS Diet., on *Distichlis spicata* (L.) Greene, was available in two collections from Delaware, two from Nebraska and two from Nevada, representing three areas approximately on the fortieth parallel of latitude, but twelve hundred miles between stations in longitude. The Delaware station is on the Atlantic sea coast; the Nebraska station is midway of the continent on the great plains, with the Allegheny range of

[14] For previous cultures see Jour. Myc. 12: 23. 1906; and 13: 197. 1907.

[15] For previous cultures see Bot. Gaz. 29: 273. 1900; Jour. Myc. 8: 53. 1902; 11: 58. 1905; 13: 196. 1907; and 14: 14. 1908.

mountains intervening; while the Nevada station is within two hundred miles of the Pacific coast, and between it and the Nebraska station intervenes the great expanse of the Rocky Mountains.

The chief question demanding solution was whether this remarkable heteroecious rust, which forms aecia on many species of hosts belonging to the families Cruciferae, Chenopodiaceae and Capparidaceae, has developed biological differences, as previous work had indicated.[16] In all thirty sowings were made. A few of these proved failures because the plants used as hosts did not grow well. The important results may be given without recording all the data.

The collections from the Atlantic coast, the first reported from east of the Mississippi river, were made by Mr. H. S. Jackson, at Lewes, Del., Nov. 16, 1907. Aecia were taken the following spring in close proximity on seedling plants, which were fruited in Lafayette, and ascertained to be *Atriplex hastata.* Ten sowings were made from these collections, using *Chenopodium album, C. hybridum, Iva frutescens* on which in the same locality aecia had also been found the following spring, and *Decodon verticillatus,* with infection only on *Chenopodium album,* which was abundant.

The mid-west collections were made, one by Rev. J. M. Bates, at Red Cloud, Neb., and the other by Mr. R. E. Stone, at Lincoln, Neb. These were sown on *Chenopodium album, C. hybridum, Sarcobatus vermiculatus, Monolepis Nuttalliana* and *Cardamine bulbosa,* with infection only on the first-named species.

The far-west collections were made by Prof. P. B. Kennedy, at Reno, Nev. They were sown on *Chenopodium album, Atriplex hastata* and *Sarcobatus vermiculatus,* at three different dates, fourteen sowings being made. Abundant infection resulted for all the hosts; nine plants giving equally vigorous results, the other five not thriving well.

These results taken with those of 1906 and 1907 show that no marked biological differences exist. The only indication of restricted adaptation is the failure to infect *Sarcobatus* from Nevada with teliospores from Nebraska, although, as predicted

[16] Jour. Myc. 13: 197. 1907, and 14: 15. 1908.

two years ago,[17] there is no difficulty in producing infection on *Sarcobatus* from Nevada with teliospores from the same region.[18]

8. PUCCINIA SEYMOURIANA Arth., on *Spartina cynosuroides* Willd., collected at Lima, Ind., by Mr. George L. Potter, was sown May 28 on *Cephalanthus occidentalis* L., giving rise to numerous pycnia June 6, and aecia June 15.[19]

9. PUCCINIA FRAXINATA (Schw.) Arth., collected at Lewes, Del., by Mr. H. S. Jackson, on *Spartina polystachya* Willd., was sown April 25 on *Adelia ligustrina, Ligustrum vulgare* and *Fraxinus lanceolata,* with infection only on the last-named species. Again on May 2 it was sown on *F. lanceolata,* giving very abundant pycnia May 13, and aecia June 2.

Another collection from the same locality, but on *Spartina stricta* Roth, was sown on *Smilax hispida* and *Fraxinus lanceolata,* with infection on the last species only.

Collections of aecia, which morphologically are identical with those of *Fraxinus,* have been made on *Ligustrum vulgare* in New York, and *Adelia segregata* in Florida. In 1904 and 1905 attempts were made to grow aecia on plants of these genera, but without success. As the telia came from the western plains, it was thought that telia from the Atlantic sea coast might show less restricted adaptation. So far we are unable to detect any difference in behavior between the rust of the salt marshes of the coast and that of the prairies of the west. It yet remains to try telia from the south along the gulf coast.[20]

10. PUCCINIA TOMIPARA Trel., on *Bromus purgans* L., collected at Scotia, Neb., by Rev. J. M. Bates, was sown on *Clematis virginiana* L. and *Thalictrum dioicum* L., May 29, giving pycnia on the first-named host only June 7, and aecia June 16, both in abundance.[21]

11. PUCCINIA ASPERIFOLII (Pers.) Wettst., on *Secale cereale* L., collected by Mr. A. G. Johnson at Lafayette, Ind., July 21,

[17] Jour. Myc. 13: 198. 1907.

[18] For previous cultures see Bot. Gaz. 35: 19. 1903; Jour. Myc. 11: 54. 1905; 12: 16. 1906; 13: 197. 1907; and 14: 15. 1908.

[19] For previous cultures see Jour. Myc. 12: 24. 1906.

[20] For previous cultures see Bot. Gaz. 29: 275. 1900; Jour. Myc. 11: 57. 1905; 12: 16. 1906; and 14: 14. 1908.

[21] For previous cultures see Jour. Myc. 11: 62. 1905; and 13: 197. 1907.

1908, was sown July 22, on *Lycopsis arvensis* L. On July 31 a few pycnia appeared, but owing to the imperfect growth of the leaf no aecia followed.

This rust has usually gone under the collective name of *P. rubigo-vera* (DC.) Wint., which has been applied to most subepidermal grass rusts not having strongly marked morphological characters. The similar leaf-rust of wheat is clearly a distinct species, judging from the failure of European investigators to make it infect *Lycopsis*, from some morphological differences, and from its different period for germination. Teliospores of the leaf-rust from both wheat and rye were tested in the laboratory at the same time by means of drop cultures, and while the rye rust grew readily, the wheat rust showed no germination.

This unequivocal, although scanty result, the first culture of the kind to be made with American material, sets at rest any doubt regarding the identity of the American and foreign leaf-rust on rye. The writer is indebted to the kindness of Dr. P. Magnus, of Berlin, Germany, and Dr. H. O. Juel, of Upsala, Sweden, for seeds of *Lycopsis* from which plants were grown for the culture work.

12. UROMYCES SCIRPI (Cast.) Burr., on *Scirpus fluviatilis* (Torr.) A. Gray, collected by the writer at Spirit Lake, Iowa, was sown on *Cicuta maculata* April 6, and gave rise to pycnia April 14, and aecia April 23, both in abundance.

13. UROMYCES HOUSTONIATUS (Schw.) Sheldon. In the spring of 1906 Dr. J. L. Sheldon observed a rust appearing on plants of *Sisyrinchium gramineum* Curtis (*S. graminoides* Bickn.), growing in contact with plants of *Houstonia caerulea* bearing *Aecidium houstoniatum* Schw. The rust on *Sisyrinchium* proved to be *Uromyces Murrillii* Ricker, until then only once collected, at the type locality in Maine. Dr. Sheldon has since made further studies in the field, and also convincing inoculations,[23] and at the same time supplied ample material for repeating his results. The methods used for other species, however, have not proved available for this one, whose teliospores do not enter a resting condition, but germinate in the sorus as soon as mature. It is the only

[22] For previous cultures see Jour. Myc. **13**: 199. 1907; and **14**: 17. 1908.

[23] Torreya **6**: 249. 1906; and **9**: 54. 1909.

heteroecious rust known to the writer, having all spore forms and yet leptopuccineous. Plants of *Sisyrinchium* bearing the rust, sent by Dr. Sheldon in 1906, flourished well in the greenhouse, but the rust gradually disappeared during the following winter. The experience was repeated in 1907. In both cases by March or April the rust had died out and did not again appear, although the plants produced fresh leaves and flourished throughout the winter months and the whole year.

Living plants of *Houstonia caerulea* bearing aecia, sent by Dr. Sheldon from Morgantown, W. Va., May 3, were potted intermixed with plants of *Sisyrinchium gramineum*. On June 8 a few uredinia were observed, but did not multiply. On May 18 similar plants were sent by Mr. H. S. Jackson from Newark, Del. These were put into small pots, and on May 23 arranged over plants of *Sisyrinchium* under a belljar, where they remained three days. On June 7 a great abundance of uredinia was observed, and on July 22 telia also in abundance. As both urediniospores and teliospores are pale and inconspicuous, they doubtless appeared earlier than the record shows.

14. GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE Schw., on *Juniperus virginiana* L., was collected by Mr. F. D. Kern and the writer at Mammoth Cave, Ky., in two rather unusual forms. One form had very large galls, very irregular and much divided. The other had very small galls, with one to three telia each, the extruded part of the telia being noticeably fusiform. Both of these forms appeared so different from the forms usually collected farther north, that it seemed possible they might be specifically distinct.

The large form was sown April 13 on *Malus Malus* (L.) Britt., *M. coronaria* (L.) Mill. and *Crataegus punctata* Jacq. On *M. Malus* pycnia appeared April 23, but the infection was so pronounced that the leaves were distorted and injured to an extent that precluded the formation of aecia, the leaves gradually dropping until September 26, when two, the only ones still remaining, were removed for the herbarium. On *M. coronaria* abundant pycnia appeared April 21, followed duly by aecia of characteristic appearance. The *Crataegus* remained free from infection.

The small form was sown April 13 on *Malus coronaria* and

Crataegus punctata, giving a few pycnia on the first, not noticed until May 4, and abundant pycnia on the last, showing April 21. Both hosts matured characteristic aecia by the latter part of June.[24]

15. GYMNOSPORANGIUM GLOBOSUM Farl., on *Juniperus virginiana* L., collected by Mr. A. B. Seymour at Manchester, Mass., was sown April 29 on *Malus Malus,* producing no infection, and on *Crataegus Pringlei* Sarg. (seedling from tree determined by Mr. W. W. Eggleston), giving abundant pycnia, and followed by equally abundant aecia. Another collection made by Mr. F. D. Kern and the writer at Mammoth Cave, Ky., was sown April 13, on *Crataegus* sp., giving pycnia April 25, but nothing further, due to the death of the host.[25]

16. GYMNOSPORANGIUM CLAVIPES C. & P., on *Juniperus virginiana* L., collected at Mammoth Cave, Ky., by Mr. F. D. Kern and the writer, was sown on two plants of *Crataegus* sp., April 13, and gave pycnia on April 25, followed by aecia by the middle of June. A sowing two days later on *Aronia nigra* gave no infection.

Another collection on the same host, made by Dr. G. P. Clinton at New Haven, Conn., was sown May 2 on *Amelanchier erecta* with no infection, and on *Crataegus* sp., giving a few pycnia, but the early maturity of the leaves checked further development.[26]

17. GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) DC., on *Juniperus Sibirica* Burgsd., collected by Mr. E. Bethel at Eldorado Springs, Colo., was sown April 28 on the leaves, petioles and stems of *Amelanchier erecta* Blanch., giving pycnia May 5, and aecia May 23, both in great abundance.[27]

18. GYMNOSPORANGIUM NELSONI Arth., on *Juniperus scopulorum* Sarg., collected by Mr. E. Bethel at Eldorado Springs, Colo., was sown May 2 on *Amelanchier erecta* and *Sorbus americana,* both showing abundance of pycnia May 10. On the first host no further development took place, as the plant was not vig-

[24] For previous cultures see Jour. Myc. 12: 13. 1906; 13: 200. 1907; and 14: 17. 1908.

[25] For previous cultures see Jour. Myc. 13: 200. 1907; 14: 18. 1908.

[26] For previous cultures see Jour. Myc. 14: 18. 1908.

[27] For previous cultures see Jour. Myc. 14: 19. 1908.

orous. On the second host abundant and characteristic aecia were formed.[28]

19. GYMNOSPORANGIUM BETHELI Kern, on *Juniperus scopulorum,* collected by Mr. E. Bethel at Eldorado Springs, Colo., was sown May 11, on *Pyrus communis,* with no infection, and on *Sorbus americana,* and *Crataegus* sp., both giving numerous pycnia, on the former host showing May 19, and on the latter not seen until May 31, although probably appearing earlier. The pycnia in both cases were followed by an abundance of characteristic aecia, well formed by July 7.[29]

20. GYMNOSPORANGIUM BOTRYAPITES (Schw.) Kern, on *Chamaecyparis thyoides* (L.) B.S.P., collected by Mr. H. S. Jackson at Newfield, N. J., was sown on *Amelanchier intermedia* Spach, May 18, giving an abundance of pycnia May 28. Although galls followed the pycnia, no aecia were formed owing to the early maturity of the leaves. This is the *Gym. biseptatum* Ellis. The rather extended synonomy is given by Kern.[30] Inconclusive cultures of this species were made by Dr. W. G. Farlow in 1877 and 1883. In 1886 Dr. Roland Thaxter[31] made cultures, and raised both pycnia and aecia, repeating his work at a later date.

21. GYMNOSPORANGIUM CORNUTUM (Pers.) nom. nov. Telia on the branches of *Juniperus Sibirica* Burgsd. were collected May 19, 1908, by Mr. F. D. Kern and Mr. E. Bethel, at Palmer Lake, Colo., and sown May 23 on *Sorbus americana,* giving an abundance of pycnia June 1, followed by numerous aecia. A second sowing was made on another plant of the same host May 25, with equally successful results, the pycnia showing June 5. In both cases the aecia were mature by August 10. A sowing May 25 on *Malus Malus* gave no infection.

Although the horn-like aecia of this species are common and often collected, this is the first time that the telia have been found in America. The telia occur on the bark of the small branches, and not at all or only rarely on the leaves. In Europe cultures of this species were made by Oersted, of Denmark, in 1866, and an account with excellent illustrations of both aecia and telia was

[28] For previous cultures see Jour. Myc. 13: 203. 1907; and 14: 18. 1908.

[29] For previous cultures see Jour. Myc. 14: 23. 1908.

[30] Bull. Torrey Club 35: 506. 1908.

[31] Proc. Am. Acad. 22: 263. 1887.

published the same year.[32] Cultures have also been made since, but most investigators in the discussion of their results have confused this with other species.

The form which has been most persistently confused in the telial stage with the present species is what in Europe has been called *G. tremelloides* Hartig, which has much larger and otherwise different telia on the bark of the larger branches of the same species of juniper, but whose aecia are the true *Roestelia penicillata,* and although occurring on *Sorbus,* are easily distinguished by being fimbriate instead of horn-like. Mr. Kern[33] has recently shown from partly circumstantial evidence that this species is the *Tremella juniperina* L., and should be called *G. juniperinum* (L.) Mart. This disposition of the name, *G. juniperinum,* appears to leave no available name under *Gymnosporangium* for the present species, and a new combination is therefore necessary. The earliest specific name is that given by Persoon to the aecial form in 1791, *Aecidium cornutum,* the first species listed under the newly established genus *Aecidium.*

The other form included by European investigators with the present species has very small telia on the leaves of the same juniper, and horn-like aecia on *Aronia.* This is discussed in the following paragraphs under the name *G. Davisii* Kern.

22. GYMNOSPORANGIUM DAVISII Kern. It is with more than usual satisfaction that I report the successful culture of this rust, as it completes a knowledge of the life cycle of a trio of species known to some extent in both Europe and America for many decades, but much confused and misunderstood. The telia occur on the leaves of *Juniperus Sibirica,* and have been sent in previous years by Dr. J. J. Davis, from Wind Lake near Racine, Wis., but could not be made to germinate. A collection made in the same locality on May 24, 1908, by Dr. J. J. Davis and Mr. F. D. Kern, was sown May 25 on *Aronia nigra, Amelanchier erecta* and *Sorbus americana,* with infection only on the *Aronia,* which showed pycnia June 12, and well matured aecia Sept. 17. Another sowing was made May 25 on *Aronia nigra,* producing a few pycnia

[32] Overs. Danske Vid. Selsk. Forh. 1866: 185–196. pl. 3, 4, with full abstract in Bull. Soc. Roy. Dan. Sci. 1866: 15–16.

[33] Science 27: 931. 1908.

June 15, but did not further develop owing to weakness of the host.

The aecia of this species have the same horn-like appearance as those of *G. cornutum*, already discussed, and the two are usually included under the same name. The only culture known to the writer, showing that the form on *Sorbus* and the similar one on *Aronia* are distinct, was made by Dr. Ed. Fischer [34] of Bern, Switzerland, and published in November, 1907. On May 29 of that year he made a sowing of teliospores from *Juniperus communis* on *Sorbus Aria, S. torminalis, S. hybrida, S. Aucuparia, Amelanchier Botryapium* and *Aronia rotundifolia* (*Amelanchier vulgaris*), and obtained an infection only on *Aronia*. He concluded from this result that the form on *Aronia* is distinct from that on *Sorbus*, but made no suggestion regarding the nomenclature. Mr. Kern,[35] however, finds diagnostic characters to separate the forms in both aecia and telia, and has supplied a name. The cultures by Dr. Fischer were not known to the writer until long after the above studies had been concluded.

23. MELAMPSORA MEDUSAE Thüm., on *Populus tremuloides* Michx., collected at Boulder, Colo., by Mr. E. Bethel, was sown April 7 on *Ribes rubrum, R. Cynosbati* and *Larix laricina*. The only infection was on the *Larix*, showing pycnia April 14, and aecia April 21.[36] When the sowing was made, it was supposed that the rust in hand was *Melampsora albertensis* Arth.; but after the result was obtained a careful inspection of the remaining material of the collection brought to light the fact that while the leaves were conspicuously covered with that rust, they also bore some sori of the more common species, and it is believed that the infection came from the latter, as recorded above.

SUCCESSFUL CULTURES REPORTED NOW FOR THE FIRST TIME:—The following species have never been cultivated, in America or elsewhere, so far as the writer knows. Much credit for the ample results is due to the mycologists who have coöperated in the work by making invaluable observations in the field and supplying suit-

[34] Archiv Sci. Phys. et Nat. 24: —. Nov. 1907.

[35] Bull. Torrey Club 35: 507. 1908.

[36] For previous cultures see Jour. Myc. 10: 13. 1904; 11: 52. 1905; and 12: 13. 1906.

able culture material with which to test their suggestions. The segregation of three additional species of western grass rusts of the type of *Puccinia rubigo-vera* is especially gratifying.

1. PUCCINIA ABSINTHII DC., on *Artemisia dracunculoides* Pursh, collected March 14, 1908, at Boulder, Colo., was sown on a plant of the same host species April 9. Another collection on the same host, collected March 24, 1908, at Spirit Lake, Iowa, by the writer, was similarly sown April 8. Both sowings gave rise to numerous pycnia first observed April 25, but doubtless appearing fully a week sooner, and were followed by abundant uredinia April 27. Owing to the early maturity of the leaves, no telia were produced in either case.

The results demonstrate that this rust has no aecial stage in its life cycle. As no pycnia in connection with the uredinia had been recorded for the species, either in America or Europe, and as aecia on various species of *Artemisia* are often collected in America, the status of the species had heretofore been most uncertain. The situation was changed, but still unsettled, by the production of aecia on *Artemisia dracunculoides* in the cultures of last year,[37] which were grown from telia on *Carex stenophylla*. The present cultures very satisfactorily complete our knowledge of the two most common rusts on *Artemisia*.

2. PUCCINIA on *Carex comosa* Boott, collected at Lewes, Del., Nov. 15, 1907, by Mr. H. S. Jackson (no. 1858), was sown April 25, on *Iva frutescens*, *Urtica gracilis*, and *Smilax hispida*, with no infection, the *Smilax* leaves, however, having died before infection could have shown. Another sowing was made May 22 on the same hosts, and also on *Myrica cerifera* and *Ambrosia trifida*. There was no infection except in the case of *Smilax*, on which pycnia were noticed June 8, although they might have appeared sooner, and were followed by aecia June 24.

The clues to this connection of telia and aecia were slight. In reference to his collection Mr. Jackson wrote that "in the locality from which the specimen came was a vine of *Smilax rotundifolia* with aecia," but he laid little stress on this association, and did not even retain a specimen of the *Smilax* rust. Upon visiting the locality again in April no *Smilax* aecia could be found, doubt-

[37] See Jour. Myc. 14: 21. 1908.

less because too early in the season. Some additional probability of the connection, however, was secured from a microscopic examination. The urediniospores of the *Carex* rust proved to be remarkably large, while the aeciospores on *Smilax,* belonging to *Aecidium macrosporum* Peck, are also unusually large, as the name indicates. But on the other hand the western *Smilax* aecia belong to a grass rust, and most *Carex* rusts have aecia on composite hosts. It is, therefore, more than usually gratifying to complete the life cycle of this heretofore undetected *Carex* rust. It is probably a more widely distributed species than shown by the range of the present known aecial collections, all of which are eastern, except one from Kansas.

Puccinia macrospora (Peck) nom. nov.

(*Aecidium macrosporum* Peck, 23rd Rep. N. Y. St. Mus. 61. 1873.)

O. Pycnia epiphyllous, few in groups on slightly discolored spots, not conspicuous, subepidermal, in vertical section flattened-globoid, 128–160μ in diameter by 80–100μ high.

I. Aecia hypophyllous, chiefly in annular groups 1.5–5 mm. across, rather short, 0.1–0.2 mm. in diameter; peridial cells linear-rhomboidal, 32–42μ long, outer wall thin, smooth, inner wall somewhat thicker, moderately verrucose; aeciospores globoid, very large, 32–42 by 37–51μ, wall colorless, medium thick, 1.5–2.5μ, thicker above, 5–10μ, rather coarsely verrucose.

On *Smilax hispida* Muhl., Long Branch, N. J., July, 1870, *G. W. Clinton;* Manhattan, Kans., June 25, 1886, *W. A. Kellerman; S. rotundifolia* L., Riverhead, Suffolk Co., N. Y., 1869, *Charles H. Peck* (type); Brown's Mills, N. J., June 26, 1889, *B. Halsted;* Seaford, Del., July 9, 1907, *H. S. Jackson;* Lewes, Del., June 6, 1908, *M. T. Cook & H. S. Jackson.*

II. Uredinia amphigenous, scattered or in longitudinal series, oblong, 0.5–1 mm. long, tardily dehiscent; urediniospores obovate or narrowly ellipsoid, rather irregular, very large, 26–37 by 40–60μ, often narrowed below to a thickened hilum; wall golden yellow, evenly thick, 2.5–3.5μ, echinulate with prominent points 3–4μ apart; pores obscure, 2 or sometimes 3, equatorial.

III. Telia chiefly hypophyllous, scattered or in longitudinal series, oblong or linear, 0.5–1.5μ long, finally naked, pulvinate, chocolate-brown, ruptured epidermis noticeable; teliospores clavate, 16–23 by 61–67μ, usually rounded or obtuse above, narrowed below, usually slightly constricted at the septum; wall pale

cinnamon-brown, paler below, medium thin, 1.5–2.5μ, much thicker at apex, 9–16μ; pedicel nearly colorless, one half to once length of spore.

On *Carex comosa* Boott, Lewes, Del., Nov. 15, 1907, *H. S. Jackson 1858.*

3. PUCCINIA on *Carex pratensis* Drej. An observation by Mr. E. Bethel at Tolland, Colo., July 25, 1907, when aecia on *Agoseris* were found in very close proximity to rusted *Carex pratensis,* led to a collection of telial material from the same spot in October following, and a successful culture. The teliospores were sown May 13, on a plant of *Agoseris glauca,* raised from seed previously sent by Mr. Bethel, and pycnia began to show May 19 in the greatest abundance. The infection was so heavy that the plant was killed before aecia were formed.

A study of all available data regarding this species has led to the conclusion that a very large part of all collections of aecia on the various species of *Agoseris* belong to this species, and not as sometimes assumed to *Puccinia Troximontis* Peck, which is common on the same hosts, but probably has no aecial stage. A description of the species is appended, but no attempt will be made at this time to cite the numerous known localities or to map out the range, which doubtless embraces much of the western mountainous region.

Puccinia patruelis sp. nov.

O. Pycnia amphigenous, rather few, in groups 0.5–1 mm. across, punctiform, inconspicuous, honey-yellow becoming brownish, subepidermal, in vertical section globoid, 96–125μ in diameter by 80–100μ high; ostiolar filaments 30–55μ long.

I. Aecia amphigenous, numerous in crowded groups 1–4 mm. across, often surrounding groups of pycnia; peridium colorless, rather short, margin finely lacerate; peridial cells rhomboidal, 18–25μ long, outer wall rather thick, 3–4μ, striate, smooth, inner quite thin, finely verrucose; aeciospores mostly globoid, 13–16 by 16–21μ; wall colorless, thin, 1μ, very finely verrucose, appearing smooth when wet.

On *Agoseris glauca* (Pursh) Greene (*Troximon glaucum* Pursh), Tolland, Colo., July 25, 1907, *E. Bethel.*

II. Uredinia chiefly hypophyllous, scattered, oblong or oval, 0.4–0.6 mm. long, rather tardily naked, cinnamon-brown; urediniospores ellipsoid or obovate-ellipsoid, 13–19 by 19–26μ; wall golden-brown, moderately echinulate, pores 2, lateral and opposite, slightly superequatorial.

III. Telia hypophyllous, scattered, numerous, oval or oblong, 0.3–0.8 mm. long, early naked, dark blackish-brown, conspicuous, ruptured epidermis noticeable; teliospores broadly clavate or spatulate, 15–23 by 32–63μ, apex rounded or obtuse, base usually narrowed, slightly constricted at the septum; wall dark chestnut-brown, paler below, moderately thin, 1.5–2μ, thicker at apex 7–13μ; pedicel slightly colored next the spore, somewhat shorter than the spore.

On *Carex pratensis* Drej., Tolland, Colo., July 25 and Oct. 19, 1907, *E. Bethel* (type).

4. PUCCINIA CINEREA Arth., on *Puccinellia airoides* (Nutt.) Wats. & Coult., collected at Arvada, Colo., by Mr. E. Bethel, was sown April 22 on *Oxygraphis Cymbalaria* (Pursh) Prantl (*Ranunculus Cymbalaria* Pursh), giving rise to pycnia April 30, and aecia May 4. A duplicate sowing was made May 7, and pycnia followed May 14, with aecia May 19. In each case the sori were produced in abundance .

The clue for this combination was obtained by Rev. J. M. Bates, who had found the same species of rust on *Poa* growing in proximity to rusted *Oxygraphis* in a number of places in Nebraska under conditions which seemed to make their genetic connection almost certain.[38] Unfortunately the culture material sent by him both this year and previously failed to germinate. The plants of *Oxygraphis* used for the cultures were supplied by him. The Colorado material was received unnamed, and from its general appearance was supposed to be on some species of *Poa*, until after the work was completed when the determination was made by Mrs. Agnes Chase of the agrostological division of the National Herbarium.

5. PUCCINIA on *Koeleria cristata*. A number of collections of this rust were sent by Mr. E .Bethel, who made the suggestion several times that it was probably connected with aecia on *Mahonia*, a suggestion that seemed to us unimportant, as the aecia on *Mahonia* in Europe are known to belong to *Puccinia poculiformis*, a cosmopolitan rust wholly unlike the one on *Koeleria*. As a collection made by Mr. Bethel April 25, 1908, at Plainview, Colo., showed germination, and as he had written that "the rust on *Koeleria* undoubtedly belongs to the aecia on *Mahonia*, for I have

[38] See Bull. Torrey Club 34: 584. 1907.

found hundreds of cases to substantiate it—I wish you would try it," a sowing was accordingly made April 30 on *Mahonia Aquifolium.* Abundance of pycnia appeared May 14, and aecia May 24. Another sowing was made June 2 on *Berberis vulgaris,* but gave no infection.

Upon examination of the available collections of aecia on *Mahonia,* which had not been given careful study before, it was discovered that they differed in a characteristic way from those on *Berberis.* They are smaller, do not produce a thickening of the leaf, and cause a rounded area of the leaf on which each group is seated to die early, turning brown and dry. From our inquiry it seems probable that no aecia on *Mahonia* belonging to *Puccinia poculiformis* have yet been found in America, although they have been so cited, but that they all should go under the present species, a description of which follows.

Puccinia Koeleriae sp. nov.

O. Pycnia chiefly epiphyllous, numerous, rather loosely arranged in groups 0.5–2 mm. across, on discolored spots, punctiform, not conspicuous, subepidermal, honey-yellow becoming blackish, in vertical section lenticular, 80–100μ in diameter by 45–65μ high.

I. Aecia hypophyllous, numerous, usually crowded in groups 1–3 mm. or more across, on discolored spots 1–7 mm. across, which finally die and turn blackish-brown, short cylindrical, 0.4–0.7 mm. high by 0.1–0.2 mm. in diameter; peridium colorless, cells rhomboidal in radial section, outer wall rather thick, 5–7μ, transversely striate, inner wall medium thin, 1–3μ, verrucose; aeciospores globoid, 13–20 by 18–26μ, wall colorless, rather thin, 1–1.5μ, evenly and finely verrucose.

On *Mahonia Aquifolium* (Pursh) Nutt. (*Berberis Aquifolium* Pursh, *B. repens* Lindl.), Ouray, Colo., July 26, 1897, *C. L. Shear,* July 2, 1907, *E. Bethel;* Victor, Idaho, July 10, 1901, *E. D. Merrill & E. N. Wilcox;* Wild Horse Island, Mont., Aug. 13, 1908, *M. E. Jones 7718;* Yellow Bay, Mont., Aug. 10, 1908, *M. E. Jones 7723.*

II. Uredinia amphigenous, in groups on discolored spots, oblong or linear, 0.1–0.2 mm. wide by 0.5–1.5 mm. long, soon naked, pulverulent, cinnamon-brown, ruptured epidermis conspicuous; paraphyses numerous, capitate or clavate-capitate, 10–16 by 42–65μ; urediniospores broadly ellipsoid, 19–26 by 23–34μ; wall cinnamon-brown, medium thick, 2–2.5μ, rather closely echinulate-verrucose; pores 4–6, scattered.

III. Telia hypophyllous, scattered, oblong or linear, about 0.1

mm. wide by 0.5–1.5 mm. long, sometimes confluent, long covered by the epidermis, grayish-black; teliospores clavate or oblong-clavate, 15–21 by 45–55μ, obtuse or truncate above, narrowed below; wall chestnut-brown, paler beneath, thin, about 1μ, thicker at apex, 3–5μ, smooth; pedicel short, slightly colored.

On *Koeleria cristata* (L.) Pers., Ouray, Colo., Aug. 23, 1907, *E. Bethel* (type); Boulder, July 31, 1905, Plainview, Aug. 5, 1905, and April 25, 1908, Marshall, June 24, 1905, Golden, July 27, 1908, all in Colo., *E. Bethel.*

6. PUCCINIA on *Bromus.* A subepidermal rust on various species of *Bromus* is common in the western mountains. Collections made by Prof. E. W. D. Holway, Sept. 4 and 7, 1907, on *B. Pumpellianus* Scribn., at Banff, Alb., were found close to *Thalictrum* bearing aecia, and believed by him to be connected, but the teliospores could not be brought to germination. A collection on *B. Porteri* (Coult.) Nash, made by Mr. F. D. Kern, Sept. 2, 1908, at Ouray, Colo., with much more definite and certain field clues, being intermixed with *Thalictrum sparsiflorum* bearing aecia, was found more tractable and was sown April 30, on *Thalictrum dioicum,* giving rise to pycnia May 9, and aecia May 30, both in abundance.

It has long been recognized that the aecia on *Thalictrum* in America belong to a number of species. No cultures, however, have been made heretofore, and only the form associated with *Tranzschelia punctata* (*Puccinia Pruni-spinosae*), common in the eastern part of the country, has been definitely placed. In Europe cultures have shown aecial forms on *Thalictrum* to belong to telia on *Agrostis, Poa, Triticum, Elymus* and *Polygonum.* Whether any of these occur in America, remains to be determined, although the last two are to be expected. The species in hand appears to be unrecorded, and a description is therefore appended. It is closely related, both morphologically and in its hosts, with *P. tomipara* Trel., which ranges throughout the central and eastern states with its aecia on *Clematis* and telia on *Bromus.* The question of their exact relationship must be left to future investigation.

Puccinia alternans sp. nov.

O. Pycnia epiphyllous, crowded in groups 0.5–4 mm. across, not conspicuous, subepidermal, in vertical section globoid, 60–96μ in diameter, 50–80μ high.

I. Aecia chiefly hypophyllous, in annular or often crowded groups 1.5–5 mm. across, cylindrical, 0.4–0.8 mm. high; peridium colorless, margin slightly recurved, finely lacerate, cells rhombic in longitudinal section, 21–29μ long, walls transversely striate, outer thick, 9–12μ, inner somewhat thinner, 5–7μ, finely verrucose; aeciospores globoid or broadly ellipsoid, 15–20 by 17–24μ, wall colorless, thin, 1–1.5μ, finely and evenly verrucose.

On *Thalictrum Fendleri* Engelm., Gunnison Co., Colo., Sept. 2, 1899, *E. Bartholomew;* Salt Lake Co., Utah, July 12, 1904, *A. O. Garrett* (Sydow, Ured. *1935;* Vestergren, Micr. rar. sel. *1002;* and Garrett, Fungi Utah. *76*); *T. occidentale* A. Gray, Victor, Idaho, July 11, 1901, *E. D. Merrill & E. N. Wilcox 1256;* Banff, Alberta, July 24, 1901, and July 6, 1907, *E. W. D. Holway; T. sparsiflorum* Turcz., Ouray, Colo., Sept. 2, 1907, *F. D. Kern;* Minnehaha, Colo., Aug. 13, 1906, *F. E. Clements; T. venulosum* Trel., Spicer, Routt Co., Colo., July, 1903, *L. N. Goodding;* Macdougal Park, Mont., July 31, 1908, *M. E. Jones.*

II. Uredinia amphigenous, scattered, oblong or linear-oblong, 0.2–0.8 mm. long, rather early naked, somewhat pulverulent, cinnamon-brown, ruptured epidermis conspicuous; urediniospores very broadly ellipsoid or slightly obovate-ellipsoid, 19–25 by 23–29μ; wall light cinnamon-brown, moderately thick, 2–2.5μ, finely echinulate; pores about 6, scattered.

III. Telia amphigenous, scattered, oblong or linear-oblong, 0.4–1 mm. long by 0.2–0.4 mm. wide, long covered by the epidermis, dark blackish-brown; teliospores clavate or clavate-oblong, 13–19 by 31–61μ, usually truncate or obtuse above, narrowed below, slightly or not constricted at the septum; wall chestnut-brown, paler below, rather thin, 1–1.5μ, thicker at apex, 3–5μ, smooth; pedicel somewhat colored, very short.

On *Bromus Porteri* (Coult.) Nash, Ouray, Colo., Sept. 2, 1907, *F. D. Kern* (type); Parley's Canyon, Utah, Aug. 18, 1908, *A. O. Garrett 1137; B. Pumpellianus* Scribn., Banff, Alberta, Sept. 4 and 7, 1907, *E. W. D. Holway; B. Richardsoni* Link, Ouray, Colo., Aug. 23, 1907, *E. Bethel.*

7. PUCCINIA on *Agropyron.* Two collections of rusted *Agropyron biflorum,* collected Sept. 2, 1907, at Lake Louise, in the Canadian Selkirks, were sent by Prof. E. W. D. Holway, with the suggestion that one of them be sown on *Thalictrum* and the other on *Aquilegia.* One collection failed to germinate, the other was sown April 18 on *Aquilegia canadensis* and *Thalictrum dioicum,* with infection only on the first, the leaves of which soon began to show hypertrophy of the tissues, and in six to seven days small yellow,

translucent spots above, followed on May 8 by aecia beneath. No pycnia were formed, as sections and microscopic examination fully proved. All American collections of aecia on *Aquilegia* in the herbarium were found to have either no pycnia associated with the groups of aecia, or more rarely only a few pycnia, a condition not before noted in heteroecious rusts of grasses and sedges.

This rust is undoubtedly quite well distributed in the western mountains, and embraces a large part of all aecia yet found in America on *Aquilegia.* It is apparently distinct from *Puccinia Agrostidis* Plowr., a European species with aecia on *Aquilegia,* and is, therefore, described as new, although there is much morphological similarity between the two.

Puccinia obliterata sp. nov.

O. Pycnia few, frequently obsolete, epiphyllous, gregarious, inconspicuous, honey-yellow, in vertical section globoid, 80–107μ in diameter; ostiolar filaments 40–75μ long.

I. Aecia chiefly hypophyllous, thickly crowded in groups 1–5 mm. across, on slightly larger discolored spots, rather short; peridium colorless, margin somewhat erose, cells rhomboidal in longitudinal section, 16–24μ in length; aeciospores globoid, or often somewhat angular, 15–19 by 18–25μ, wall colorless, thin, about 1μ, very minutely verrucose, appearing nearly smooth when wet.

On *Aquilegia caerulea* James, Buffalo Pass, Park Range, Colo., Aug. 13, 1898, *C. L. Shear & E. A. Bessey* (Ellis & Ev., Fungi Columb. *1474*); Trapper's Lake, Colo., Aug. 14, 1894, *Prof. C. S. Crandall 100;* Beulah, N. Mex., June 29, 1909, *Mrs. W. P. Cockerell;* North Vermilion Creek, Sweetwater Co., Wyo., July 17, 1897, *A. Nelson; A. elegantula* Greene, Ouray, Colo., July 12, 1907, *F. E. & E. S. Clements* (Crypt. Form. Colorad. *592*); *A. flavescens* Wats., Banff, Alb., July 25, 1901, Laggan, Alb., July 21, 1907, *E. W. D. Holway; A. formosa* Fisch., Skamania Co., Wash., Aug. 12, 1886, *W. N. Suksdorf; A. truncata* Fisch. & Mey., Jackson Co., Oreg., July 9, 1903, *E. B. Copeland* (Sydow, Ured. *1767*).

II. Uredinia chiefly hypophyllous, scattered, linear, small, soon naked, pulverulent, cinnamon-brown, ruptured epidermis noticeable; urediniospores globoid or broadly ellipsoid, 16–23 by 19–29μ; wall light cinnamon-brown, medium thin, 1.5–2.5μ, finely echinulate-verrucose, pores 6–8, scattered.

III. Telia chiefly epiphyllous, scattered, often crowded and con-

fluent, oblong or linear, 0.1–0.3 mm. wide by 0.5–2 mm. long, tardily naked, blackish; teliospores clavate or clavate-oblong, 13–19 by 29–51μ, obtuse or somewhat rounded above, narrowed below, very slightly or not constricted at the septum; wall dark chestnut-brown, paler below, thin, 1–1.5μ, thicker at apex, 3–5μ, smooth; pedicel colored, short.

On *Agropyron biflorum* R. & S., Lake Louise, Laggan, Alb., Sept. 2, 1907, *E. W. D. Holway* (type); *A. caninum* (L.) Beauv., Laggan, Alb., Sept. 2, 1907, *E. W. D. Holway*.

8. PUCCINIA MUHLENBERGIAE Arth. & Holw. collected by Mr. E. Bartholomew, March 23, 1908, at Stockton, Kans., on *Muhlenbergia glomerata* Trin., was sown at different dates on ten different species of host plants, including *Hibiscus militaris* Cav., with no infection. Another collection with same data, but on *M. mexicana* (L.) Trin., was sown April 22 on *Dalea laxiflora* with no infection, again May 15 on same host, and on *Ceanothus americanus* and *Xanthoxylum americanum*, still with no infection. A third attempt was made by sowing June 12, on *Baptisia tinctoria*, *Rudbeckia laciniata* and *Callirrhoe involucrata*. Little culture work is done so late in the season as this last attempt, and it was supposed no infection had been secured, when on July 23 an abundance of aecia, accompanied by a few pycnia, were noticed on the plant of *Callirrhoe*. Although not under continuous observation, it is believed they came from the sowing.

Many attempts have been made to cultivate the rusts found on various species of *Muhlenbergia*,[39] twenty-six species of hosts having been used. The year following the reported success by Prof. W. A. Kellerman[40] in sowing rust from *Muhlenbergia mexicana*, collected in Ohio, on *Hibiscus Moscheutos*, a strong effort was made to repeat his work with material from Kansas and Nebraska, but with no definite result. Mr. E. Bartholomew more than once suggested that the material he supplied was connected with *Aecidium Napaeae* A. & H., as the results have seemingly shown.

The aecia obtained by Professor Kellerman, and those secured by the writer, are quite unlike. The former are rather large and

[39] For record of unsuccessful sowings see Bot. Gaz. 35: 11. 1903; Jour. Myc. 11: 51. 1905; and 13: 192. 1907.

[40] Jour. Myc. 9: 109, 232. 1903.

numerous, and bright orange-yellow, the latter are small, fewer and nearly or quite colorless. Upon a careful examination of the telial material used in the two successful trials, it is found that while that from Kansas is the true *Puccinia Muhlenbergiae*, that from Ohio is *P. dochmia* B. & C., or at least quite distinct from the other. Considerable more study is needed to fully clear up the relationship of the *Muhlenbergia* rusts.

9. GYMNOSPORANGIUM LIBOCEDRI (P. Henn.) Kern. For many years the only known locality for the telia of this rust has been in northern California at a place rarely visited by botanists. While Mr. F. D. Kern during January, 1908, was working upon material in the herbarium of Dr. W. G. Farlow at Harvard University, a collection of this rust was seen from Eugene, Ore., made by Dr. A. R. Sweetser, of the University of Oregon. There was also in the herbarium a collection, from the same locality and by the same person, of *Aecidium Blasdaleanum* D. & H. on *Crataegus*. This *Aecidium* has also been taken by more than one collector from the region of the *Libocedrus* rust in California. The *Crataegus* rust is stated by Dr. Dietel, in a note appended to the original description, to be "a true *Aecidium*, and does not belong to the genus *Roestelia* comprising the aecidial stages of *Gymnosporangium*." Recent very careful study confirms Dr. Dietel's statement regarding its morphological resemblances, for in the peridial cells, the spores, and the mode of dehiscence, which provide the chief generic characters, it is wholly unlike the form genus *Roestelia*.

In order to secure culture material Dr. Sweetser was appealed to. He responded promply with telial collections on *Libocedrus decurrens*, which came through the mails in perfectly fresh condition. For his efficient aid Dr. Sweetser is entitled to much credit. A sowing was made April 1 on *Crataegus Pringlei* and *Amelanchier canadensis*, giving no infection on the *Amelanchier*, but on the *Crataegus* numerous pycnia began to show April 12, followed on April 20 by an abundance of well-formed aecia. Another sowing was made on *Crataegus* sp. April 4, resulting in such a heavy infection, the pycnia showing April 14, that the leaves were killed before there was time for aecia to form.

The aecia secured by the culture agree perfectly with *Aecidium*

Blasdaleanum, being wholly lacking in Roestelial characters. The aberrant form of the aecia is to a certain extent paralleled by the unusual form of the telia, which led Dr. P. Hennings to describe the telial stage as a *Phragmidium.*

10. GYMNOSPORANGIUM sp. nov. The series of circumstances leading to the discovery of telia that made the present cultures possible has been briefly narrated in the introductory paragraphs of this report. On April 10, 1908, a collection was made at Mammoth Cave, Ky., by Mr. F. D. Kern and the writer, on the branches of *Juniperus virginiana,* and on the following day a growing plant of the same species only six inches high with large sori on the main axis was obtained. The first collection was sown April 13 on *Porteranthus stipulatus* (*Gillenia stipulacea*), producing an abundance of pycnia April 21, but the plant did not thrive, soon dying outright. Another sowing of the same material was made April 15 on *Porteranthus* and also on *Crataegus punctata,* with no infection on the latter, but very abundant infection on the former, pycnia showing April 23, and aecia May 25. Another sowing April 16 on *Porteranthus* gave such a heavy infection, pycnia showing April 23, that the plant was soon killed. Still another sowing April 27, and one April 28, gave very abundant pycnia May 5, followed by numerous well-grown aecia that matured May 25 from the first sowing, and May 31 from the second. The small plant of *Juniperus* had been potted, and continued to thrive. Teliospores from this living plant were placed on a plant of *Porteranthus* May 11, and on May 17 an abundance of pycnia appeared, followed by numerous aecia that were mature by June 7.

The aecia from the cultures proved to be identical with those collected by Rev. Demetrio in 1884, at Perryville, Mo., and issued as No. 3323 in Rabenhorst-Winter, Fungi europaei. They are especially remarkable in the fact that they occur on a non-pomaceous host, an herbaceous perennial, although heretofore the aecia of all species of *Gymnosporangium* have been supposed to occur exclusively on the ligneous plants of the family Malaceae. With the aecia of this species going outside the Malaceae for its host, and those of the preceding species falling outside the genus *Roestelia,* two of the most marked characteristics pertaining to the first stage of the *Gymnosporangia* are shown to have exceptions.

Gymnosporangium exterum Arthur & Kern sp. nov.

O. Pycnia epiphyllous, rather few, very sparsely disposed in definite groups 3–6 mm. across, prominent, subepidermal, in vertical section flattened-globoid, 95–125μ in diameter by 65–90μ high; ostiolar filaments 48–65μ long.

I. Aecia hypophyllous, very sparsely disposed in large groups 4–10 mm. or more across, on larger discolored areas, 0.1–0.3 mm. in diameter by 0.5–0.8 mm. high; peridium soon becoming rather finely lacerate almost to base, spreading but not revolute, cells usually seen only in face view, 10–18 by 58–100μ, inner wall rugose with rather narrow ridges running downward and outward, side walls rugose, 3–5μ thick; aeciospores broadly ellipsoid or globoid, 17–21 by 21–26μ; wall very pale cinnamon-brown, medium thick, 2–2.5μ, very finely verrucose, pores evident, 8–10, scattered.

On *Porteranthus stipulatus* (Muhl.) Britton (*Gillenia stipulacea* Nutt., *Spiraea stipulata* Muhl.), Perryville, Mo., 1884, *C. H. Demetrio* (Rab.-Wint., Fungi Eur. *3323*); Mammoth Cave, Ky., June, 1870, *T. F. Allen.*

III. Telia caulicolous, from a permanent mycelium, appearing on fusiform swellings 2–6 cm. long by 0.5–1.5 cm. or more in diameter, causing a considerable roughening and exfoliation of the bark, flattened, irregular and indefinite in outline, usually anastomosing over practically the whole surface of the swelling, light chocolate-brown becoming yellowish by germination; teliospores ellipsoid, 18–23 by 32–42μ, rounded or sometimes narrowed above and below; wall light cinnamon-brown, rather thin, 1–1.5μ, usually slightly thicker at apex, pores 1 in each cell, apical; pedicel cylindrical, uniform, slender, 3–4μ in diameter, very long.

On *Juniperus virginiana* L., Mammoth Cave, Ky., April 10, 1908, *J. C. Arthur & F. D. Kern* (type).

SUMMARY

The following is a complete list of the successful cultures made during the year 1908. It is divided into two series: species that have previously been grown in cultures and reported by the writer or other investigators, and species whose culture is now reported for the first time.

A. Species Previously Reported

1. PUCCINIA KUHNIAE Schw.—Teliospores on *Kuhnia Hitchcockii* A. Nels., sown on *K. eupatorioides* L.

2. PUCCINIA PECKII (DeT.) Kellerm.—Teliospores on *Carex stipata* Muhl., sown on *Onagra biennis* (L.) Scop.

3. PUCCINIA SAMBUCI (Schw.) Arth.—Teliospores on *Carex lurida* Wahl., sown on *Sambucus canadensis* L.

4. PUCCINIA CARICIS-SOLIDAGINIS Arth.—Teliospores on *Carex sparganioides* Muhl., sown on *Solidago canadensis* L.

5. PUCCINIA ELEOCHARIDIS Arth.—Teliospores on *Eleocharis palustris* (L.) R. & S., sown on *Eupatorium perfoliatum* L.

6. PUCCINIA ANGUSTATA Peck.—Teliospores on *Scirpus cyperinus* (L.) Kunth., sown on *Lycopus communis* Bickn. and *L. americanus* Muhl.

7. PUCCINIA SUBNITENS Diet.—Teliospores on *Distichlis spicata* (L.) Greene, sown on *Chenopodium album* L., *Atriplex hastata* L. and *Sarcobatus vermiculatus* (Hook.) Torr.

8. PUCCINIA SEYMOURIANA Arth.—Teliospores on *Spartina cynosuroides* Willd., sown on *Cephalanthus occidentalis* L.

9. PUCCINIA FRAXINATA (Schw.) Arth.—Teliospores on *Spartina polystachya* Willd. and on *S. stricta* Roth, sown on *Fraxinus lanceolata* Borck.

10. PUCCINIA TOMIPARA Trel.—Teliospores on *Bromus purgans* L., sown on *Clematis virginiana* L.

11. PUCCINIA ASPERIFOLII (Pers.) Wettst.—Teliospores on *Secale cereale* L., sown on *Lycopsis arvensis* L.

12. UROMYCES SCIRPI (Cast.) Burr.—Teliospores on *Scirpus fluviatilis* (Torr.) A. Gray, sown on *Cicuta maculata* L.

13. UROMYCES HOUSTONIATUS (Schw.) Sheldon.—Aeciospores on *Houstonia caerulea* L., sown on *Sisyrinchium gramineum* Curtis.

14. GYMNOSPORANGIUM JUNIPERI-VIRGINIANAE Schw.—Teliospores on *Juniperus virginiana* L., sown on *Malus coronaria* (L.) Mill., *M. Malus* (L.) Britt. and *Crataegus punctata* Jacq.

15. GYMNOSPORANGIUM GLOBOSUM Farl.—Teliospores on *Juniperus virginiana* L., sown on *Crataegus Pringlei* Sarg.

16. GYMNOSPORANGIUM CLAVIPES C. & P.—Teliospores on *Juniperus virginiana* L., sown on *Crataegus* sp.

17. GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) DC.—Teliospores on *Juniperus Sibirica* Burgsd., sown on *Amelanchier erecta* Blanch.

18. GYMNOSPORANGIUM NELSONI Arth.—Teliospores on *Juniperus scopulorum* Sarg., sown on *Amelanchier erecta* Blanch. and *Sorbus americana* Marsh.

19. GYMNOSPORANGIUM BETHELI Kern.—Teliospores on *Juniperus scopulorum* Sarg., sown on *Crataegus* sp. and *Sorbus americana* Marsh.

20. GYMNOSPORANGIUM BOTRYAPITES (Schw.) Kern.—Teliospores on *Chamaecyparis thyoides* (L.) B.S.P., sown on *Amelanchier intermedia* Spach.

21. GYMNOSPORANGIUM CORNUTUM (Pers.) Arth.—Teliospores on *Juniperus Sibirica* Burgsd., sown on *Sorbus americana* Marsh.

22. GYMNOSPORANGIUM DAVISII Kern.—Teliospores on *Juniperus Sibirica* Burgsd., sown on *Aronia nigra* (Willd.) Britt.

23. MELAMPSORA MEDUSAE Thüm.—Teliospores on *Populus tremuloides* Michx., sown on *Larix laricina* (DuR.) Koch.

B. Species Reported Now for the First Time

1. PUCCINIA ABSINTHII DC.—Teliospores on *Artemisia dracunculoides* Pursh, sown on same host.

2. PUCCINIA MACROSPORA (Peck) Arth.—Teliospores on *Carex comosa* Boott, sown on *Smilax hispida* Muhl.

3. PUCCINIA PATRUELIS Arth.—Teliospores on *Carex pratensis* Drej., sown on *Agoseris glauca* (Pursh) Greene.

4. PUCCINIA CINEREA Arth.—Teliospores on *Puccinellia airoides* (Nutt.) Wats. & Coult., sown on *Oxygraphis Cymbalaria* (Pursh) Prantl.

5. PUCCINIA KOELERIAE Arth.—Teliospores on *Koeleria cristata* (L.) Pers., sown on *Mahonia Aquifolium* (Pursh) Nutt.

6. PUCCINIA ALTERNANS Arth.—Teliospores on *Bromus Porteri* (Coult.) Nash., sown on *Thalictrum dioicum* L.

7. PUCCINIA OBLITERATA Arth.—Teliospores on *Agropyron biflorum* R. & S., sown on *Aquilegia canadensis* L.

8. PUCCINIA MUHLENBERGIAE Arth. & Holw.—Teliospores on *Muhlenbergia glomerata* Trin., sown on *Callirrhoe involucrata* (T. & G.) A. Gray.

9. GYMNOSPORANGIUM LIBOCEDRI (P. Henn.) Kern.—Teliospores on *Libocedrus decurrens* Torr., sown on *Crataegus Pringlei* Sarg.

10. GYMNOSPORANGIUM EXTERUM Arth. & Kern.—Teliospores on *Juniperus virginiana* L., sown on *Porteranthus stipulatus* (Muhl.) Britt.

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ILLUSTRATIONS OF FUNGI—IV

William A. Murrill

Puffballs are the safest of all fungi for the beginner in mycophagy, none of them being poisonous; and they are at the same time excellent and easy to obtain. The species represented on the accompanying plate are mostly devoid of color and may be easily distinguished without its use. Certain other species requiring color will be illustrated in later plates.

Puffballs are good either stewed, or fried in thin slices with butter, but cooked in the latter way they are usually very rich. Being tender they cook quickly and are easily digested. They should as a rule be cut open before cooking to see that they are not too old and that they are really puffballs. If they are white and firm like cream cheese inside, showing no yellow or brownish discoloration, they are of the right age to use. If the interior shows no special structures, but is smooth and homogeneous, then one may be sure he has a puffball. The "egg" of the deadly amanita contains the young cap and stem inside, which is readily seen when the egg is cut; and the "egg" of the stinkhorn shows the stem and a green mass inside surrounded by a layer of jelly-like substance.

Pleurotus sapidus, a common edible mushroom found on dead trunks and stumps, is represented in one view in Fig. 5. This species will be described later, when more adequately illustrated.

Lycoperdon cyathiforme Bosc

Large Field Puffball

Plate 15. Figure 1. $\times \frac{2}{3}$

Peridium large, subglobose to turbinate, 5–15 cm. in diameter, the base short and thick; surface smooth, glabrous or finely floccose, whitish-gray or brown, becoming purplish and rimose-areolate above with age, cuticle thin, easily separating; capillitium

and spores purplish-brown, falling away in age with the upper part of the peridium, leaving a persistent cup-shaped base with a ragged margin; spores sessile, globose, distinctly echinulate, purplish-brown, 5–7μ in diameter.

This puffball occurs commonly in the eastern United States in meadows and pastures where the common mushroom may be expected to grow, but its excellent qualities appear to be unknown to most persons. It is the largest puffball in this region, except the giant puffball, which is much rarer and grows in the woods. Bosc originally described this species from the cup-shaped sterile base, hence the specific name is hardly appropriate.

Amanita phalloides Fr.

DEADLY AMANITA. DESTROYING ANGEL

Plate 15. Figure 2. $\times \frac{1}{2}$

Pileus convex to expanded, 5–15 cm. broad; surface smooth, glabrous, white, slightly viscid when moist; margin entire, concolorous: flesh white, not objectionable to the taste, although at times emitting a slightly disagreeable odor; gills white, not changing color, broad, rounded at the base, free from the stem: spores globose, smooth, hyaline, 7–8μ in diameter: stem long, slender, smooth, white, stuffed or hollow, 7–15 cm. long, 1–1.5 cm. thick, decorated above with a large white annulus and sheathed at the swollen base with a conspicuous white volva or "death-cup" 2.5–4 cm. in diameter.

The above description applies only to the white form here figured. Other forms will require color. The species is common during summer and autumn in open groves and along the edges of woods.

The most important part of the deadly amanita is the sheath at the base of the stem known as the "death-cup," which is well shown in the illustration. This is what remains of the outer coat of the "egg" after the cap has burst from it and has been carried upward by the growing stem. The ring on the stem is similar to that of the common mushroom, but the gills are white, both when young and old, those of the common mushroom being at first pink, then black. Nothing can be told from the color of the upper surface of the cap because it varies so

much, being pure white, yellowish, brownish or blackish. Sometimes the surface is perfectly smooth and at other times it is adorned with pieces of the "death-cup," which were carried up on it when the cap burst through the roof of the "egg."

When gathering mushrooms it is exceedingly important to get all of the stem and not leave a portion of it in the ground, since the "death-cup" may thus be overlooked. Mushrooms should not be gathered in the "button" stage unless mature specimens are growing in the same place, otherwise an "egg" of one of the poisonous kinds may be collected by mistake.

If distress is experienced within four or five hours after eating mushrooms, it is probably a case of indigestion or minor poisoning and should readily yield to a prompt emetic. If, however, from eight to twelve hours have elapsed since eating the mushrooms, disagreeable symptoms should be taken very seriously, since it is almost certain that one of the deadly narcotic poisons is at work. A physician should at once be called and the heart action stimulated by a hypodermic injection of about one sixtieth of a grain of atropine, which should be repeated twice at half hour intervals. Atropine is an antidote to the poison of the "fly amanita," which paralyzes the nerves controlling the action of the heart. If the "deadly amanita" has been eaten, the atropine will probably do no good, and death will surely follow if the amount eaten is sufficient.

Lycoperdon gemmatum Batsch

STUDDED PUFFBALL

Plate 15. Figure 3. $\times \frac{2}{3}$

Peridium turbinate, subumbonate, usually whitish or gray, 2–4 cm. in diameter, narrowed below into a short, stem-like base; cortex of long, erect spines or warts of irregular shape scattered among small granular and more persistent ones, all of which finally fall away, leaving the surface reticulated with fine dotted lines; capillitium and spores greenish-yellow, at length pale brown, columella present; spores globose, smooth or slightly roughened, about 4μ in diameter.

This is a very common species, growing usually on the ground

in woods. Although extremely variable, it is recognized without much difficulty by the character of its spiny covering, the larger spines somewhat resembling the shape of cut gems. The plants generally grow near together and are occasionally cespitose, but are rarely so crowded as in the case of the pear-shaped puffball.

Agaricus campestris L.

COMMON MUSHROOM

Plate 15. Figure 4. $\times \frac{1}{2}$

See MYCOLOGIA for March, 1909, for a full description and colored illustrations of this species. Fatal mistakes are sometimes made by extremely ignorant and careless persons who are unable to distinguish the common mushroom from the white form of the deadly amanita. The differences between the two are very marked, even if the base of the stem with the volva has been left in the ground. The common mushroom may at once be known by its pink gills, which become almost black with age, while those of the deadly amanita are always white.

Dictyophora duplicata (Bosc) Ed. Fisch.

VEILED STINKHORN

Plate 15. Figure 6. $\times 2$

The "egg" of this poisonous and very fetid stinkhorn may be found beneath the soil or slightly projecting above the ground, about buildings and near old stumps in fields or borders of woods. It is nearly white, with a pinkish tinge, rather heavy, firm when very young, but becoming softer to the touch as it matures. When cut through in a very young stage, as shown in the figure, the young white cap and stem may be seen within, surrounded by a zone of gelatinous matter, which has a pinkish coloration. In later stages, the lines of division are more marked. This "egg" is considered very poisonous and must be carefully distinguished from puffballs when collecting the latter for food. The mature stinkhorn, after the development from

the "egg" is complete, would never be considered edible on account of its very objectionable odor. A colored figure, with full description, of this species will appear in the next number of MYCOLOGIA.

Lycoperdon Wrightii B. & C.

SEPARATING PUFFBALL

Plate 15. Figure 7. $\times \frac{2}{3}$

Peridium globose or subglobose, sessile or nearly so, white, 1–4 cm. in diameter; surface densely covered with stellate spines or pyramidal warts that fall away at maturity, exposing the glabrous or minutely velvety, buff-colored inner peridium; capillitium and spores dingy olivaceous, columella present; spores globose, sessile, finely granular, about 4μ in diameter.

This species is very common during summer and autumn along paths and in dry pastures, usually occurring in great numbers and reminding one of a collection of white marbles of various sizes scattered upon the ground. Upon closer observation the characteristic coating of spines appears, which breaks into flakes and falls away at maturity, as is well shown in the figure.

MYC

LEPTOLEGNIA FROM NORTH CAROLINA

(WITH PLATE 16, CONTAINING FIVE FIGURES)

W. C. COKER

Leptolegnia caudata De Bary, the only known species of the genus, was found twice by De Bary from mountain lakes in Germany in 1881 and 1884, and has not certainly been seen since. In Rabenhorst's Kryptogamen Flora (1^4: 346) Dr. Fischer refers to a sterile plant that he thought might be this species, and Dr. Roland Thaxter writes me that he has seen a form without sexual reproduction that resembled *Leptolegnia*.

The genus was defined by De Bary as follows:* "Eine Oospore, das ganze Oogon lückenlos erfüllen; sonst wie *Saprolegnia";* and the species was described in some detail a little later.†

At Chapel Hill, North Carolina, in the fall of 1908 I found in a culture jar of algae, that had been brought into the laboratory from pools in the vicinity, a species of water mold that proved to belong to this genus. It has now been cultivated for almost a year and carefully studied in all stages.

At the last meeting of the North Carolina Academy of Science in May of this year (Reported in Science **30**: 188. Aug. 6, 1909) I referred our plant to a new species, and I still think that from some points of view it might be so considered. But further cultivation in different media shows so great a variability that I have decided to take the conservative course and refer the North Carolina plant to *L. caudata*.

In my observations certain facts have been established that add to or are at variance with De Bary's description, and it may be well to record them.

My observations on the sporangia agree with De Bary's except that in old cultures the sporangia may become very complex from

* Botanische Zeitung **46**: 609. 1888.

† Botanische Zeitung **46**: 631. 1888.

the extension of a single sporangium into a number of adjoining branches. In Fig. 1 is shown such a sporangium that was observed before and during the discharge. All the spores emerged from the tip of one of the branches (at *a* in the figure) and the spores at the tips of the other branches had to travel all the way down these and out at *a*.

De Bary does not mention the shape or behavior of the spores, but I found them to exhibit some remarkable peculiarities. In nearly all cases they emerge from the sporangium much drawn out, as long, more or less cylindrical rods, with the two cilia attached to the center on one side. As soon as they escape, the two ends of the rod begin to fold backward, away from the cilia, and fuse as they go, until by complete fusion they lose their identity and form a pear-shaped spore with the cilia near the tip, and the long axis at right angles to the original rod. By killing the spores during emergence they were caught in all stages of this transformation and drawn to illustrate the process, as shown in Fig. 5; in which *a* shows several spores that were killed in the sporangium. They become more elongated as they pass out and on emergence have the shape shown in *b* or *c*.

The dimensions of the oögonia were not given by De Bary, but I find them to be 30μ or 40μ in diameter, and essentially spherical except where modified by slight protuberances to meet the antheridia. Judging from the figures, the oögonial branches as seen by De Bary were shorter than I found them to be, but in other respects not different. Two, three, or even more antheridia to the oögonium were common in my material. In one case I counted five. More than two are not mentioned by De Bary. The antheridial branches are generally borne as rather short offshoots from a slender main branch that shows a marked tendency to twine about the larger female branches (Figs. 2 and 3), but they may terminate a long branch. They are always of diclinous origin.

The transference of material from antheridium to oöspore was left in doubt by De Bary, and I have not seen the actual passage of such material. The evidence however is convincing that fertilization does take place. The antheridium is full of protoplasm when it is cut off, and is empty a little later; and the amount of

protoplasm contained in it is so large as to make its disappearance practically impossible in any other way except by discharge. Moreover, when the empty antheridium is pulled from the oögonium a distinct circular opening can be seen in it and the opening in the original membrane on the oögonium can be easily made out (Fig. 4).

The oögonia are very rarely found, and this accounts for my failure to see the fertilization process. I had cultivated the plant for about three months before the first oögonia appeared, and they were matured during the Christmas recess. They have been produced only two or three times since, and that only sparingly, notwithstanding my efforts to induce sexual reproduction by cultures on various insects and in different chemical solutions. The results of some of these experiments are as follows:*

1. On gnat in .05 per cent. haemoglobin solution in shallow dish. Growth was about as extensive as in water but there was a much more profuse branching, especially near the ends of the hyphae. The difference was easily visible to the naked eye. No sexual reproduction.

2. On gnat in a solution of ½ haemoglobin (.05 per cent.) and ½ $Ca(NO_3)_2$ (.2 per cent. sol.). About twenty oöspores, all with antheridia.

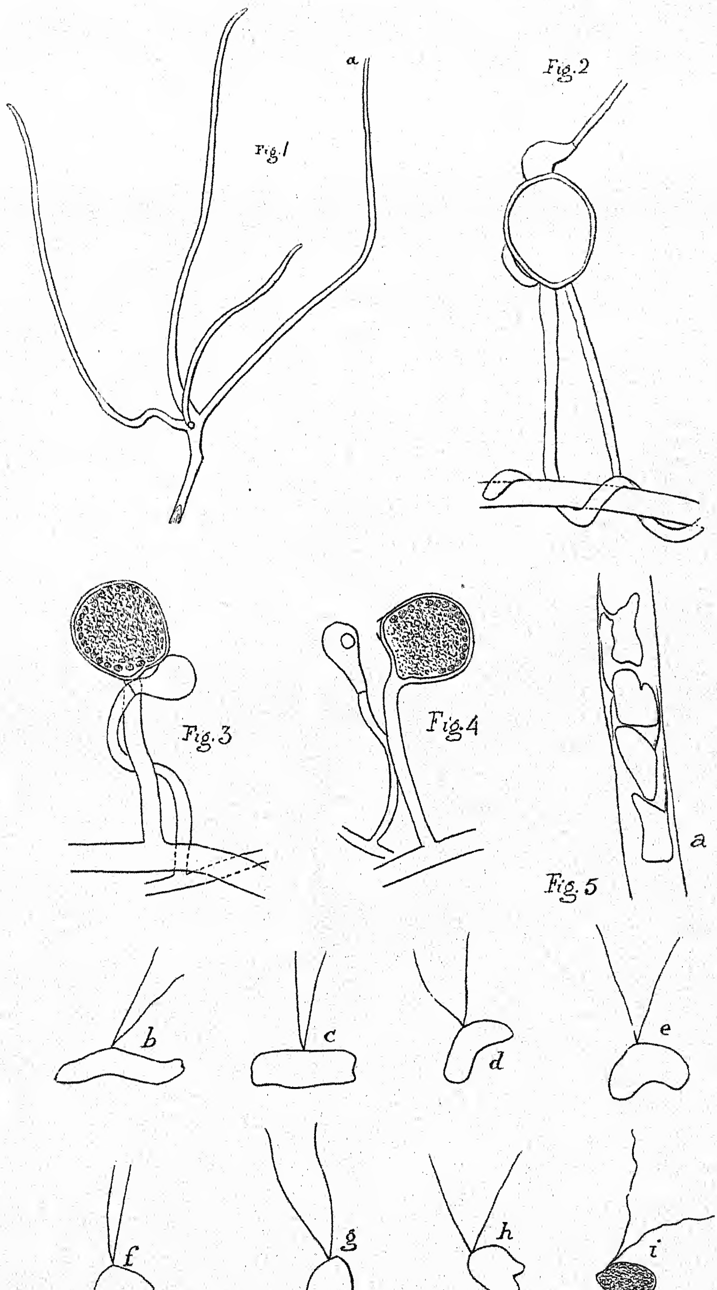
3. Cultures made on gnats in shallow petri dishes gave no oöspores in any of the following solutions (haemoglobin in .05 per cent. sol. and chemicals in .2 per cent. solution in all cases):

Haemoglobin + KNO_3
Haemoglobin + $K_6H_3(PO_4)_2$
Aqueous sol. of $Ca(NO_3)_2$
Aqueous sol. of KNO_3
Aqueous sol. of $K_6H_3(PO_4)_2$

Cultures on gnats, flies, wasps, mosquitoes and spiders showed no noticeable differences. Cultures under several inches of water were unfavorable for the formation of either sexual or asexual reproductive organs.

UNIVERSITY OF NORTH CAROLINA,
CHAPEL HILL, N. C.

* The methods of Kauffman were followed in the main. See Annals of Botany 22: 361. 1908.



LEPTOLEGNIA CAUDATA

Myc

SOME FUNGI GROWING BOTH ON CONIFEROUS AND DECIDUOUS TREES

Lars Romell

In Murrill's tenth article on the Polyporaceae of North America, it is stated that *Daedalea unicolor** has no choice beyond deciduous wood as regards host. As a rule this is certainly true, but there is no rule without exception. I have seen this species growing on *Pinus abies* L. (*Picea excelsa* Lk.) at least two or three times in different places here at Stockholm, but not abundantly. As the fact struck me, I made myself quite sure of the correctness of the observation.

Among other species occasionally met with on *Pinus abies,* although generally growing on leaf trees, I will mention *Polyporus zonatus,* which I have seen but once, and *Polyporus adustus,* which I have seen some few times on our Swedish spruce, while both are very common and abundant on their ordinary hosts.

If *Fomes Hartigii* of Allescher and Schnabl (*Ochroporus fulvus* Schroeter) is really identical with *Fomes robustus* Karsten, which latter is frequent on living oak trees at Stockholm, this might be another example of host change, as *Fomes Hartigii* is said to grow on *Abies.* It is asserted positively that *Polyporus fumosus* (which also parades under the name of *P. holmiensis, P. salignus, P. scanicus,* etc.) has been collected on *Pinus silvestris* in Germany. I have seen it only on deciduous trees.

Polyporus giganteus I have met with but twice in Sweden. The first time I got it from an oak in Omberg (July 13, 1889). The other time (October 16, 1904) I saw it here at Stockholm growing amongst grass on the ground, but fixed to a stump nearly concealed in the earth. So far as I could see, this stump was the remainder of a tree of *Pinus silvestris,* which species also grew

* For convenience I use here the old familiar names.

all around the spot. I have not microscopically established the determination of the host but I think it is still possible to do it. My first thought was that it possibly might be the true *Polyporus resinosus* of Fries, a species which I had not seen before or had not been able to distinguish from *Polyporus benzoinus,* with which there was some resemblance, but my plant was thin and lobate or incised (although not in the same degree as the specimen from oak) and the spores were globose, 4–6μ diam. (while the spores of *P. benzoinus* are sausage-shaped, 4–9 $\times$ 1.5–3μ). The blackening also agreed with the oak form.

Polyporus pinicola is another example, as *Polyporus marginatus* is now universally, I think, considered identical with it. But here the needle trees seem to be the preferred hosts and the occurrence on broad-leaved trees more rare. On *Cerasus* I saw this fungus but once, on *Alnus* perhaps twice and on *Betula* several times.* *Polyporus annosus,* common on *Pinus abies* L., grows sometimes on stumps of deciduous trees. I think I saw it but once or twice on such a host.

Among the Hydnaceae, *Radulum orbiculare* is a decided broad-leaved tree inhabitant (*Betula, Sorbus, Salix,* etc.). Nevertheless, G. V. Schotte has collected it also on *Abies pectinata.*

Of the Thelephoreae, I will mention *Stereum ferrugineum* (or *S. rubiginosum,* which is now considered a synonym). This grows generally on oak here in Sweden but is found sometimes on *Pinus. Stereum tabacinum* is also a lover of deciduous hosts, notably *Corylus* and *Salix,* but I collected it recently on *Juniperus,* and it seemed to thrive on this host, for it had covered the whole trunk. *Corticium evolvens* is found mostly on broad-leaved trees, but occurs also on needle trees. The same can be said of *Corticium cinereum, C. confluens, C. velutinum,* and others.

Of the gill-bearing Hymenomycetes I will mention only two. I think that others as well as myself consider *Pholiota squarrosa* a deciduous tree fungus. I have, however, seen it also in con-

* Whether *Polyporus rotundatus* (see Fries, Hymenomycetes, page 554, sub *P. helveolus*) is the same as *P. pinicola,* as I have reason to suspect, will perhaps never be determined, as no type specimen exists so far as I know. According to a note, Dr. Lindblad found his fungus "*in codice vetustiori Betulæ,*" while Fries refers it "*ad truncos Pini.*"

nection with our Swedish spruce and in one instance I saw it growing about a meter above the ground on this tree. One might scarcely expect to find so decided a needle tree resident as *Lenzites saepiaria* on other hosts. Nevertheless, I saw it one time on *Cerasus*.

The list above given is, of course, far from complete and is to be considered only an introduction to the subject.

STOCKHOLM, SWEDEN.

ASCOMYCETES AND LOWER FUNGI—FASCICLE III

Guy West Wilson and Fred Jay Seaver

51. Botryosphaeria Quercuum (Schw.) Sacc. Syll. Fung. **1**: 456. 1882.

Sphaeria Quercuum Schw. Schr. Nat. Ges. Leipzig **1**: 40. 1818.

The species is apparently very variable and numerous synonyms have been sighted. For more complete synonymy see Ellis and Everh. N. Am. Pyrenom. 546. Bronx, N. Y. City, spring, 1907. F. J. S.

52. Cenangium furfuraceum (Roth) Sacc. Syll. Fung. **8**: 565. 1889.

Peziza furfuracea Roth, Cat. Bot. **2**: 257 *pl. 9, f 3*. 1800.
Dermatea furfuracea Fries, Summa Veg. Scand. 362. 1849.
Encoelia furfuracea Karst. Myc. Fenn. **1**: 218. 1871.

Rather common in N. Dakota on dead branches of *Corylus* sp. Coll. spring, 1908. F. J. S.

53. Cercospora Davisii Ellis & Everh. Proc. Acad. Nat. Sci. Phil. **1891**: 89. 1892.

On leaves of *Melilotus alba* Desv., Fayette, Iowa, July 2, 1909. G. W. & D. D. Wilson.

Rather abundant in some patches of the host but on the whole not common.

54. Hypocrea Richardsoni Berk. & Mont.; Berk Grevillea **4**: 14. 1875.

Common on dead branches of *Populus tremuloides* Michx. Fargo, N. Dakota, spring, 1908. F. J. S.

According to Schrenk (Bull. Torrey Club **21**: 388) this is a *Corticium*.

55. PHYLLOSTICTA LABRUSCAE Thüm, Pilze des Wein. 189. 1878.

Guignardia Bidwellii (Ellis) Vala & Ravaz, Bull. Soc. Myc. Fr. 8: 63. 1892.

On leaves of *Vitis vulpina* L., Fayette, Iowa. July 2, 1909. G. W. W.

According to M. E. Roze (Bull. Soc. Myc. Fr. 14: 24. 1892) *Phoma uvicula* Berk. & Curtis and *Phyllosticta viticola* Thümen represent stages in the development of this fungus.

56. HELMINTHOSPORIUM GRAMINUM Rabenh. Herb. Viv. Myc. II. 332. 1856.

On leaves of *Hordeum vulgare* L., Fayette, Iowa, June 29, 1909. G. W. W.

Locally rather destructive to barley and quite prevalent the present season.

57. HYPOCREA CITRINA (Pers.) Fries, Summa Veg. Scand. 383. 1849.

Sphaeria citrina Pers. Obs. Myc. 1: 68. 1796.

On dead branches of *Tilia americana* L. while still on the tree, especially occurring where the bark is broken, Fargo, N. Dakota, 1907–8. Observed in this locality only on basswood.

58. HYSTEROGRAPHIUM KANSENSE Ellis & Everh. Erythea 2: 22. 1894.

On bark of *Quercus* sp., Mt. Pleasant, Iowa, summer, 1905. F. J. S.

The specimens have been compared with the type of this species and conform well in all respects.

59. MICROSPHAERA ALNI (Wallr.) Salmon. Mem. Torrey Club. 9: 129. 1900.

Alphitomorpha alni Wallr. Ann. Wett. Ges. 4: 237. 1819.

On leaves of *Syringa vulgaris*, Bronx, N. Y. City, autumn, 1908. F. J. S.

For more complete synonymy see Salmon, l. c.

60. NECTRIA EPISPHAERIA (Tode) Fries, Summa Veg. Scand. 388. 1845.

Sphaeria episphaeria Tode, Fungi Meckl. **2**: 21. 1791.

On old sphaeriaceous fungi, Fargo, N. Dakota, 1907–8. F. J. S.

61. NECTRIA SEMINICOLA Seaver, Mycologia **1**: 21. 1909.

On seeds of skunk cabbage, *Spathyema foetida,* autumn, 1906. F. J. S.

The material issued under this number is cotype. The species has been observed during the present season, 1909, on similar habitat.

62. PERONOSPORA CALOTHECA de Bary; Rabenh. Herb. Viv. Myc. II. *673*. 1858.

On *Galium boreale* L., Fayette, Iowa, July 1, 1909. G. W. W.

Local but where present rather abundant. While other species of *Galium* grow with the infected one, the fungus appears to be confined to the one host.

63. PERONOSPORA PARASITICA (Pers.) Fries, Summa Veg. Scand. 493. 1849.

Botrytis parasitica Pers. Obs. Myc. **1**: 96. *pl. 5, f. 6.* 1796.

Peronospora Dentariae Rabenh. Fungi Europ. *86*; Fl. **42**: 436. 1859.

On *Dentaria laciniata* Muhl., Fayette, Iowa, May 14, 1908. G. W. W.

Not abundant on the present host, at least locally.

64. PERONOSPORA TRIFOLIORUM de Bary, Ann. Sci. Nat. IV. **20**: 117. 1863.

On leaves of *Astragalus carolinianus* L., Fayette, Iowa, June 5, 1908. G. W. W.

Rather an uncommon species which is locally abundant on this host. The form on *Astragalus* may be distinct from that on *Trifolium* and *Medicago*.

65. PHYSALOSPORA AURANTIA Ellis & Everh. N. Am. Fungi *2355*; N. Am. Pyrenom. 304. *pl. 27, f. 1–6.*

On leaves of *Astragalus* sp., Kulm, N. Dakota. Coll. J. F. Brenckle.

The specimens distributed here conform well with the type.

66. PLASMOPARA PYGMAEA (Unger) Schröter; Cohn, Krypt. Fl. Schles. 3^1: 234. 1886.

Botrytis pygmaea Unger, Exanth. Pfl. 172. 1833.

Peronospora pygmaea Unger, Bot. Zeit. 5: 315. 1847.

On *Anemone caroliniana* Walt., Fayette, Iowa, June 9, 1908. G. W. W.

When present this little fungus covers large areas of the host with a very dense growth of conidiophores.

67. PLEONECTRIA BEROLINENSIS Sacc. Michelia 1: 123. 1878.

Nectria Ribis Niessl, Verh. Nat. Ver. Brumm. 2: 114. 1865 (homonym).

Pleonectria Ribis (Niessl) Karst. Medd. Soc. Fauna Fl. Fenn. 5: 42. 1879.

On cultivated currants, Fargo, N. Dakota, summer, 1908. F. J. S.

68. RHYSOTHECA VITICOLA (Berk. & Curtis) G. W. Wilson, Bull. Torrey Club 34: 407. 1907.

Botrytis viticola Berk. & Curtis; Berkeley, Jour. Hort. Soc. London 6: 289. 1851 (hyponym).

Peronospora viticola Casp. Monatsb. K. Preuss. Akad. Wiss. 1855: 331. 1855 (hyponym); de Bary, Ann. Sci. Nat. IV. 20: 125. 1863.

Plasmopara viticola Berl. & De-Toni; in Sacc. Syll. Fung. 7: 338. 1888.

On *Vitis vulpina* L., Fayette, Iowa, June 25, 1909.

This destructive fungus appears as spots on the leaves as a fruit rot, or involves both stem and leaf of the new growth covering them with a dense mould-like growth and causing some hypertrophy.

69. RHYTISMA SALICINUM (Pers.) Fries, Syst. Myc. **2**: 568. 1822.

Xyloma salicinum Pers. Tent. Disp. Fung. 5. 1797.

On leaves of *Salix* sp., Kulm, N. Dakota, 1908. Coll. J. F. Brenckle.

70. SEPTORIA SCROPHULARIAE Peck, Ann. Rep. N. Y. St. Mus. **28**: 57. 1879.

On leaves of *Scrophularia marylandica* L., Fayette, Iowa, July 2, 1909. G. W. W.

71. SPHAERELLA FRAGARIAE (Tul.) Sacc. Syll. Fung. **1**: 505. 1882.

Sphaeria Fragariae Tul. Ann. Sci. Nat. IV. **5**: 112. 1856.
Stigmatea Fragariae Tul. Sel. Fung. Carp. **2**: 288. *pl. 31.* 1863.
Ramularia Tulasnei Sacc., Michelia **1**: 536. 1879.
Ramularia Fragariae Peck, Ann. Rep. N. Y. St. Mus. **34**: 30. *pl. 3, f. 12, 15.* 1883.

Conidia on leaves of *Fragaria virginiana* Duchesne, Fayette, Iowa, July 2, 1909. G. W. W.

72. SYNCHYTRIUM AECIDIOIDES (Peck) n. n.

Uredo aecidioides Peck, Ann. Rep. N. Y. St. Mus. **24**: 88. 1872.
Uredo Peckii Thümen, Myc. Univ. 538. 1876.
Synchytrium fulgens decepiens Farl. Bull. Bussey Inst. **2**: 229. 1879.
Synchytrium decepiens Farl. Bot. Gaz. **10**: 240. 1885.

On *Falcata comosa* (L.) Kuntze, Fayette, Iowa, July 3, 1909. G. W. & D. D. Wilson.

73. TAPHRINA JOHANSONII Sadeb. Jahrb. Hamd. Wissensch. Anst. **10**: 74. 1893.

On capsules of *Populus tremuloides* Michx., Fayette, Iowa, May 18, 1909. G. W. & D. D. Wilson.

The bright yellow color of the infected capsules makes this a very conspicuous fungus. Not common but where present the trees were thoroughly infected.

74. URNULA CRATERIUM (Schw.) Fries, Summa Veg. Scand. 364. 1849.

Peziza craterium Schw. Schr. Nat. Ges. Leipzig 1: 117. *pl. 1, f. 7–11.* 1818.

Fayette, Iowa, May, 1908. G. W. W. & H. H. Strauss.

Locally common on fallen branches in woodlands.

75. XYLARIA HYPOXYLON (L.) Grev. Fl. Edin. 335. 1824.

Clavaria Hypoxylon L. Sp. Pl. 1182. 1753.

Sphaeria Hypoxylon Pers. Obs. Myc. 1: 20. 1796.

On rotten wood, Bronx, N. York City, 1907. F. J. S.

Myc

NOTEWORTHY ADDITIONS TO THE MYCOLOGICAL HERBARIUM

A Mushroom Cultivated in Formosa

An interesting edible mushroom grown for the first time in Formosa has been recently brought to my attention by Mr. W. H. Ballou, who donated a specimen of it to the Garden herbarium.

Fig. 5. The "Shiitake" on *Quercus cuspidata.*

This mushroom is known as "Skiitake," and grows on the "Shii," a species of oak (*Quercus cuspidata*). It is highly esteemed and largely used by the Japanese and Chinese on account of its excellent flavor. During the past year its cultivation was introduced into the mountains of Formosa, where the oak grows abundantly. The tree is cut down and trimmed of its

smaller branches and rice water is thrown over it at intervals to prepare it for the mushroom. In Formosa it takes about a year to get the first crop, while in Japan it usually takes three. The mushrooms improve in size and flavor up to the third year. The price ranges from thirty to fifty cents per pound. About 10,000 pounds are now grown by a company organized for the purpose of encouraging the growth of agricultural products in Formosa, and this amount will be greatly increased in the near future.

During a recent visit to the famous Cockpit Country in the island of Jamaica, I was much interested to discover that "the edible mushroom" of that region grew on logs in the woods, in a manner similar to that described above, only there is no attempt at cultivating it. The natives search for it very eagerly and consider it a great delicacy. They call it "Junju"; whether a corruption of some African name or an attempt to pronounce the word "fungi," I have not been able to determine.

WILLIAM A. MURRILL.

BOLETACEAE FROM KENTUCKY

A valuable collection of Boletaceae, consisting of seventy-five numbers, with complete descriptive notes made from fresh specimens, has recently been sent in for determination by Professor Bruce Fink, of Miami University, Oxford, Ohio. The collection includes about thirty species, several of which have not been reported before from that region. *C. auriflammeus* and *C. Curtisii* deserve special mention.

Most of these specimens were collected by Professor Fink in August and September, 1909, at Big Hill, Kentucky, about five miles from Berea, in the edge of the Cumberland Mountains, at an elevation of 900 to 1,700 feet. The others were found in the vicinity of Oxford, Ohio. The species are as follows:

Ceriomyces affinis, C. auriflammeus, C. auriporus, C. Betula, C. bicolor, C. communis, C. crassus, C. Curtisii, C. eximius, C. fumosipes, C. inflexus, C. miniato-olivaceus, C. pallidus, C. retipes, C. Russellii, C. subtomentosus; Boletinellus merulioides; Boletinus Berkeleyi; Fistulina hepatica, F. pallida; Gyroporus castaneus; Rostkovites granulatus; Strobilomyces strobilaceus; Suillellus Frostii, S. luridus; Tylopilus felleus, T. indecisus.

WILLIAM A. MURRILL.

NEWS AND NOTES

Dr. E. J. Durand, instructor in botany in Cornell University, spent the last two weeks of August at the Garden, consulting the collections of fleshy discomycetes in preparation of manuscript for "North American Flora."

Miss M. F. Barrett, instructor in the State Normal School, Montclair, N. J., was in residence at the Garden during the month of July, preparing a monograph of the North American species of gelatinous fungi.

A temporary fellowship has been established at Cornell University by the Niagara Sprayer Company to investigate the value of commercial lime-sulfur mixtures as fungicides.

The subject of "Variation of Fungi due to Environment" is treated by F. L. Stevens and J. G. Hall in the *Botanical Gazette* for July, 1909. The effect of the following factors on the growth of different species of fungi is discussed: density of colonies; density of mycelium; chemical relations; light relations; and variations due to unknown factors. The subject of variation in spore measurement under different conditions is discussed at some length. The article is illustrated with thirty-seven figures.

A revision of the genus *Sphaerosoma* by Casimir Rouppert appeared in the *Bulletin de l'Acadêmie des Sciences de Cracovie* for June, 1909. Four species of this genus are recorded for the world. The single North American species, *Sphaerosoma echinulatum* Seaver, is also recorded for Europe.

The Minnesota Botanical Studies for June, 1909, contains a monograph of the Pezizales, Phacidiales, and Tuberales of Minnesota by Daisy S. Hone, who for several years past has been

engaged in a study of the discomycetes of that state. The monograph is accompanied by six plates.

The *Agricultural Bulletin of the Straits* for July, 1909, contains descriptive accounts of two fungi parasitic on Para rubber trees. One is an ascomycete, which first attacks the shoots and later descends to the trunk, killing the tree very quickly, in much the same way as does the chestnut canker in this vicinity. Cutting away affected branches and spraying with Bordeaux mixture is recommended for this disease.

The other disease is caused by a species of *Hymenochaete*, probably *H. noxia* P. Henn., which attacks the roots of the tree, slowly covering the larger roots with a bright brown layer, causing them to dry up. No remedy is recommended.

Mr. Lars Romell makes the following observation regarding the spores of *Polyporus Colossus*:

"I do not know on what observation the statement is based that this species has hyaline spores. I fear, however, that it will not be found correct. I have noted that their color is a mixture of cream and olivaceous, a color which the hymenium also assumes, at least in advanced age. The spores may be hyaline in young stages, perhaps, but when mature they are always colored, I think. In the type specimen at Upsala the spores were cream-olivaceous, obovate, punctate-scabrous, $15–18 \times 8–12 \mu$. The hyphae of the hymenium were about 3 (or 2–5) μ thick and those of the punk $3–6 \mu$ thick, and undulate.

"It may be added that *Polyporus leucocreas* and *Ganoderma obokense* have the same characters as *Polyporus Colossus*, and, in my opinion, should be considered synonyms of it."

Circular No. 35 of the U. S. Department of Agriculture, by Perley Spaulding, deals with the causes and distribution of the white pine blights in the United States. During the last five years complaints of white pine leaf-blight have been coming in, which complaints are becoming more frequent from year to year. The case is of special importance since we are now dependent upon second growth of white pine for our lumber supply, and

the young white pine is especially susceptible to diseases which may result from the most trivial wound.

The blight is characterized by the death of the apical portion of the leaf, which may extend over one fourth or one third of its length or entirely to the base, causing premature falling of the leaves. During the early stages of the disease the leaves become reddish-brown, but a few months later the color fades so as to be much less conspicuous, which change of color is likely to be mistaken for an improved condition of the trees.

The leaf-blight is known to extend from the southern part of Maine and northern New Hampshire and Vermont to the Hudson Valley, central Pennsylvania and along the Alleghanies to western North Carolina, but apparently does not occur in the higher altitudes of the north, as it has not yet been found in the Adirondacks.

Several species of fungi have been found to accompany the blight, any one or all of which may have to do with its existence. Such physiological factors as winter-killing, sun-scald, injurious gases, etc., may or may not be concerned. The disease may cause the death of the affected trees in a single season or it may require two or more seasons to accomplish its purpose.

A study of the disease seems to indicate that comparatively few trees have been killed and timber owners have no occasion for undue alarm, as in many cases the trees show a tendency to recover from the blight. There is at present no known reason for cutting healthy trees of young pine among which are scattering trees affected by the leaf-blight.

Dr. William W. Ford, of the Bacteriological Laboratory of Johns Hopkins University, delivered an address before a special meeting of the Boston Mycological Club, June 14, 1909, on the distribution of poisons in mushrooms, which was printed in *Science* for July 23. Dr. Ford has carefully investigated and experimented with a number of species of mushrooms in recent years, and his conclusions, as given in this address, probably represent the most reliable information on this subject at the present time.

The deadly *Amanita phalloides,* with its several varieties, was

found to contain two poisons, one active in the raw plant only and the other resisting both cooking and digestion. Atropine is still considered a perfect antidote for muscarine, found in *Amanita muscaria,* but another poison may perhaps be present also in this species.

Amanita rubescens and *A. solitaria* contain the same blood-destroying toxin found in uncooked plants of *A. phalloides,* but this is destroyed by heat. On the other hand, this poison is absent in *A. strobiliformis, A. chlorinosma, A. radicata* and *A. porphyria,* and the deadly and resistant amanita-toxin is present in quantity. *A. Frostiana* has not yet been proven poisonous, which indicates that it is quite distinct from *A. muscaria.*

Russula emetica is mentioned as a strong irritant; *Helvella esculenta* contains a poison similar to that found in uncooked *A. phalloides;* certain phalloids of fetid odor are uniformly fatal to hogs; species of *Volvaria* are questionable; and *Boletus luridus* occasionally disturbs the system for a time, but has a very objectionable taste, which prevents it from being eaten in quantity. No authentic cases of true poisoning, according to the author, are known among the black-spored or brown-spored agarics. In conclusion, Dr. Ford remarks:

"The examination of these various species of fungi, representing now nearly twenty distinct forms, demonstrates one or two facts which should be particularly emphasized. In the first place, our methods of chemical analysis of mushrooms, and especially the methods of isolating their poisons, are now so developed that a little material, two or three small specimens in fact, and even one good-sized plant, may be studied and an opinion be given as to the properties of the species. In the second place, a more extended investigation should be carried out in regard to the properties of all the mushrooms believed on clinical grounds to be poisonous, but of which no laboratory study has thus far been made. Finally, such a piece of work, to be of lasting value to Science, can only be accomplished through the coöperation of trained mycologists who can identify with certainty the species of mushrooms selected for study."

MYC

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New names, and the final members of new combinations, are in **bold face type.**